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PACIFIC OCEAN

RELIEF MAP OF CALIFORNIA.

BULLETIN NO. 100.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
A. C. TRUE, Director.
Irrigation Investigations, Elwood Mead, Expert in Charge.

REPORT

OF

IRRIGATION INVESTIGATIONS IN CALIFORNIA

UNDER THE DIRECTION OF

ELWOOD MEAD,

ASSISTED BY

**WILLIAM E. SMYTHE, MARSDEN MANSON, J. M. WILSON, CHARLES D. MARX, FRANK SOULÉ,
C. E. GRUNSKY, EDWARD M. BOGGS, and JAMES D. SCHUYLER.**

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LETTER OF TRANSMITTAL.

U. S DEPARTMENT OF AGRICULTURE.
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., June 15, 1901.

SIR: I have the honor to transmit herewith, and to recommend for publication, a report on irrigation investigations conducted in California during 1900 by the Office of Experiment Stations in cooperation with the California Water and Forest Association, under the supervision of Prof. Elwood Mead, expert in charge of irrigation investigations in this Office. The investigations consisted of observations by irrigation experts on the existing legal, engineering, and agricultural conditions along nine typical streams used for irrigation in the State. The growing value and increasing scarcity of water are creating an imperative need for better laws to control the distribution of streams in California, and there is much public interest in this subject in the State. The general conclusions agreed to by all of the agents and experts taking part in the investigations, with the views set forth in their separate reports, will, it is believed, indicate the nature of the reforms required to put agriculture under irrigation in California on a more enduring and satisfactory basis, and thus to promote the more rapid and successful development of the State's resources.

Respectfully,

A. C. TRUE, *Director.*

Hon. JAMES WILSON,
Secretary of Agriculture.

LETTER OF SUBMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Irrigation Investigations,
Cheyenne, Wyo., June 1, 1901.

Sir: I have the honor to submit for publication the report of an investigation of the irrigation problems of California made under my supervision during 1900, but carried out by the experts in charge with only general directions from me.

The reports of these experts aim to present an accurate statement of existing conditions along nine streams in different parts of the State, which are believed to be typical of what exist elsewhere. The names of those in charge and the location of their labors are as follows:

Name of expert.	Name of stream.
William E. Smythe	Susan River.
Marsden Manson	Yuba River.
James M. Wilson	Cache Creek.
C. E. Grunsky	Kings River.
Frank Soulé	San Joaquin River.
C. D. Marx	Salinas River.
Edward M. Boggs	Los Angeles River.
James D. Schuyler	San Jacinto River and Sweetwater River.

In submitting their reports these experts have acknowledged their obligations for assistance received from the following persons:

William E. Smythe to his assistants, Albert Halen, C. E., of Standish, and W. D. Minckler, of Susanville; Marsden Manson to Mr. H. D. H. Connick, assistant engineer, and Mr. F. F. S. Kelsey, draftsman; Mr. J. M. Wilson to Mr. Frank Adams and Mr. P. N. Ashley, assistants; C. E. Grunsky to his two field assistants, Mr. E. F. Haas and Mr. F. C. Hermann, and to Mr. J. C. Henkenius, draftsman.

Acknowledgment of courtesies from parties not directly employed in the investigations are also made. To the engineers and officers of a number of mining and water companies on Yuba River; to the chamber of commerce and officials and citizens of Yolo, Lake, and Colusa counties; to a number of professors of the University of California and Leland Stanford Junior University; to railroad companies; to canal companies, and to many individuals. The large number of persons who have cooperated with these experts and assisted in this work prevents a more detailed acknowledgment of courtesies extended.

To the California Water and Forest Association special acknowledgment is due because of the financial aid received. The substantial character of this assistance is shown by the amounts of its contribution, as given in the following summary:

Kings River	$1,125.00
San Joaquin River	1,125.00
Salinas River	375.00
Yuba River	375.00
Honey Lake Basin	375.00
Cache Creek	625.00
Maps, reports, etc	625.00

In addition to the above, individuals and local associations have contributed $250 toward the expenses of work on Stoney Creek, now being carried on by the Department of Agriculture, but not included in this report. The work in southern California was paid for entirely by the Department. This included the reports of Messrs. Schuyler and Boggs, and studies of the duty of water carried on by Mr. Irving to be published in a later bulletin.

Acknowledgment is also due to Mr. R. P. Teele, editor of this office, for assistance in editing these reports and preparing them for publication, and to Mr. C. E. Tait, draftsman.

Respectfully,

ELWOOD MEAD,
Irrigation Expert in Charge

DR. A. C. TRUE, *Director*.

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IRRIGATION INVESTIGATIONS IN CALIFORNIA.

THE AGRICULTURAL SITUATION IN CALIFORNIA,

By Elwood Mead,
Irrigation Expert in Charge.

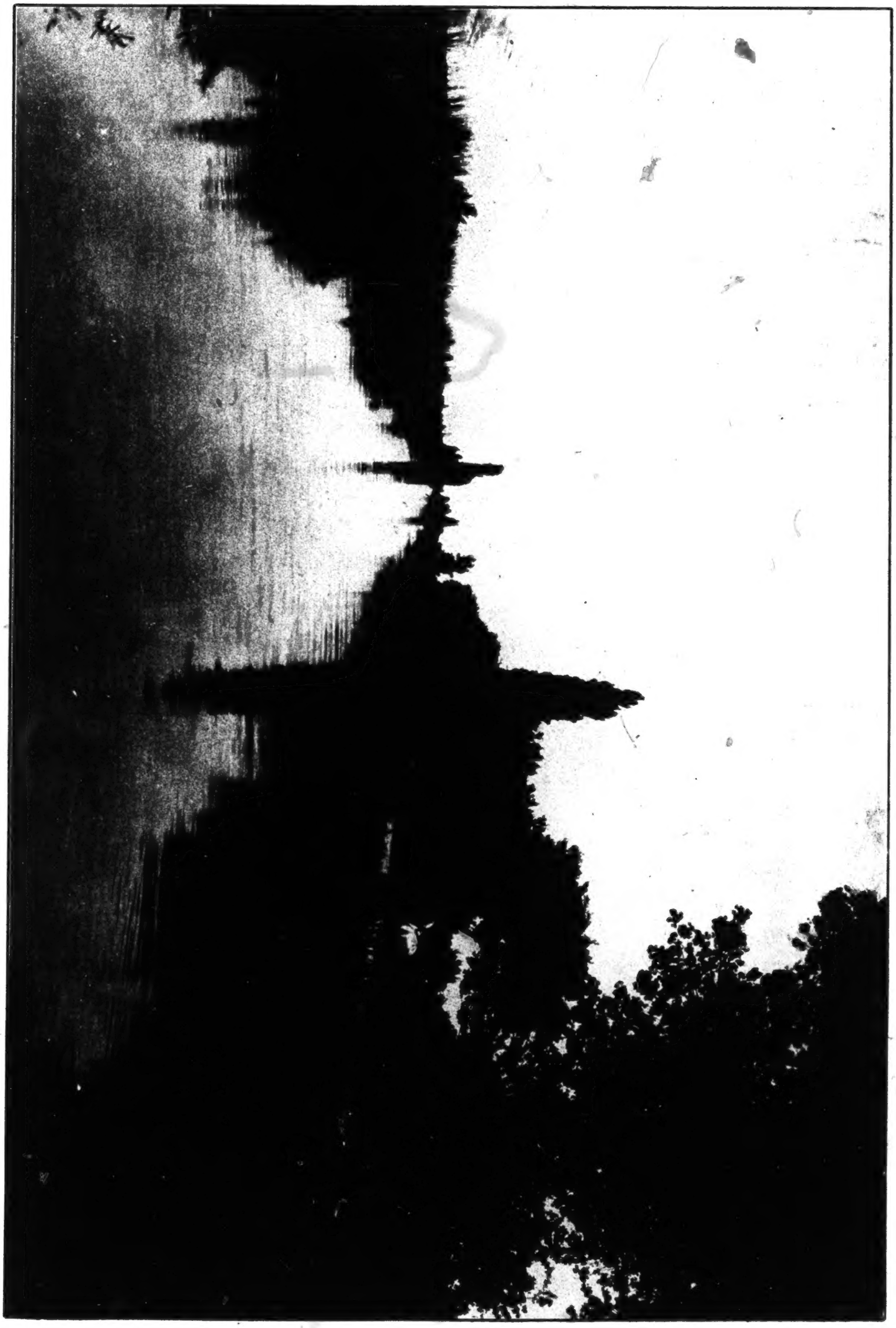
INTRODUCTION.

As an agricultural State California stands alone. No other humid or arid commonwealth has as diversified products or high-priced farming land. In some respects the climate is marvelous in its possibilities. The usual limitations imposed by latitude are here set aside. Oranges ripen as early and surely at Oroville, 100 miles north of San Francisco, as at San Diego, 500 miles south of that city, and much of the State has the unique distinction of being able to grow all the products of New England and of Florida on the same acre of land. Sacramento, which has the same latitude as southern Illinois, is surrounded by districts where blue-grass lawns are shaded by palm and orange trees. The summers are not too hot for the turf nor the winters too cold for the trees. Nowhere east of the mountain barrier formed by the Sierras are these products grown together. On the east side of the range one has to travel south 500 miles to find a palm tree, while in Illinois the apple takes the place of the orange. It is the only State where crops can be harvested with absolute assurance that rain will not fall to injure them, yet where these crops can be grown by the aid of rainfall alone. In much of the cultivated portion of the State irrigation is not a matter of necessity, but of choice. If a farmer is content to raise wheat, ditches may be dispensed with. If he wishes to add alfalfa and oranges, and to beautify his surroundings with the perpetual green of a lawn, he must provide an added water supply.

Although irrigation is not a necessity, it is everywhere of value, because its magic brings into full fruition all of the attractions with which the State is so generously endowed. By its aid midsummer can be made almost as lovely as spring. It obviates or lessens the dust and discomfort of the rainless season and makes it possible to create rural homes which on the whole represent an average of human comfort hardly to be equaled elsewhere in this country. It completes the marvelous combination which makes winter a season of seed time instead of stagnation; which gives to farmers many of the products of the Tropics with the climate of the temperate zone; which withholds moisture in harvest time and thus relieves the husbandman of the most serious vicissitude of regions of ample rainfall. It is an aggregation of advantages which those who live elsewhere find it hard to believe exists, and which the people of the State do not fully appreciate.

The delay in extending the watered area is due to obstacles local in character and origin and not met with in equal measure in any other arid State. In no other State are rivers used for both irrigation and navigation. The owners of canals which divert the Sacramento and San Joaquin have to keep in mind the steamboats which ply on these rivers from San Francisco to Stockton and Red Bluffs. There are many miles of pipe lines in the Sierras which bear witness of an interrupted but not abandoned application of water in placer mining and which represent rights to streams which seem to grow more numerous and valuable with age and disuse. The recent improvements in transmitting power by electricity have enormously enhanced the utility of California streams for the generation of power. It used to be that the factory had to go to the stream; now the stream is carried to the factory, even when far removed. The power of Tuolumne River is being carried 160 miles to San Francisco, and this enterprise is only the forerunner of a development which will not cease until the latent force of the cascades in every mountain canyon has been harnessed in one way or another to the wheels of California's industries. When to these various interests we add the needs of irrigation, the management and control of the water supply assumes an overshadowing importance. No other element outside of land is of such general and primary necessity or is destined to exert an equal influence on the growth of the State in wealth and population. The problem before the people of the State is to adjust the diverse and conflicting interests of navigation, mining, power, and irrigation; to provide a just and stable basis for titles to water in order to create an industrial civilization suited to the climatic and economic needs of a State where water and land are both important.

The history of irrigation in California, from the time when the mission fathers first turned its streams on the thirsty soil, has shown an unusual mingling of romance and selfishness. Men have worked with each other and for each other in cooperative ditch enterprises, many of which have been remarkably successful, while on the other hand they have sought to place their neighbors in bondage by speculative appropriations of streams. Along with remarkable ability shown by engineers and irrigators in diverting and using rivers has gone controversy over water rights in the



A TYPICAL IRRIGATION SCENE—BRANCH OF FRESNO CANAL.

courts and armed raids to destroy headgates or interfere with the use of canals. Ability and success in material development have been rendered futile by marked failure in legislation. Some of the best examples of ditch construction to be found in this country are in California, but the operation of these works is embarrassed by legislation which violates every principle necessary to enduring success.

The present situation is the natural outcome of this combination of favorable and adverse conditions. Although irrigated land in California has a greater value than in any other arid State, the watered area is as yet insignificant when compared to what is possible, and the rate of extension is slow. While water rents for a higher price than elsewhere, more runs to waste than is used. There are few places in the world where rural life has the attractions or possibilities which go with the irrigated home in California, yet immigration is almost at a standstill and population in some of the farmed districts has decreased in the past ten years. It is certain that some potent but not natural cause is responsible for this, and this cause seems to be a lack of certainty or stability in water rights which has given an added hazard to ditch building and been a prolific source of litigation and neighborhood ill feeling. Farmers who desire to avoid the courts and live on terms of peace and concord with their neighbors avoid districts where these conditions prevail. Hence the obstacle to California's growth seems to have been unfavorable social conditions, rather than lack of natural opportunities.

There is a widespread feeling that the time has come to improve this situation. The call for the convention which gave the first impulse to this investigation was due to the promptings of an awakened public spirit, seeking not solely the larger use of the State's resources, but the creation of better social and industrial conditions. It is hoped that the facts herein presented will at least show the need of action. They ought to do more; they ought to lead to such changes in laws and methods as will define and make stable all existing rights and protect those rights when defined as far as human agencies can accomplish this result.

The reports which follow give the results of the most comprehensive study yet made in this country of the social, legal, and economic problems created by the use of streams to reclaim arid lands. It has been carried out under the direction of the Office of Experiment Stations of the U. S. Department of Agriculture, but its effectiveness has been greatly increased by the financial aid extended by the Water and Forest Association and other local associations of the State. The appropriations for these studies made by Congress and the contributions of money and time by the public-spirited citizens of California indicate a growing recognition of the fact that irrigation is more than a matter of ditches and acres. It is beginning to be realized that the arid West has some problems which are new to the people of this country; that there is being laid in the West the foundation of an industrial civilization different from that of the East and capable of better results, if wise laws and just policies shall prevail. It is a civilization which requires that every farmer shall be a thinker as well as a worker, and in which the value of the home depends more on institutions than on either a fertile soil or ample water supply. No State illustrates these truths more clearly than California. It is the most instructive field for the prosecution of these investigations in the United States, because in no other State have water and land so great a value, and because in no other State are the evils and abuses of imperfect and inadequate legislation so clearly manifest.

REFORM OF WATER LAWS A STATE MATTER.

An impression seems to prevail in the minds of some of those interested that this investigation is destined to result in a national law for the establishment of water rights which would overturn or unsettle all existing ones. This, as will be seen from the conclusions of the special agents in charge, is not regarded as either possible or desirable, and it is certainly not the present or ulterior purpose of anyone connected with the irrigation investigations of the Department of Agriculture. Rights to water are based on State laws or State customs. There is no reason to believe they will be overturned except with the sanction of those most concerned, and when there is a desire for reform or change no legislative agency can respond so quickly and effectively as that of the State. The object of this investigation, and more broadly of the kindred ones carried on by the Department of Agriculture, is to furnish the facts needed as a basis for correct conclusions and safe legislation.

Since, therefore, the power to act and responsibility for action rests with those directly concerned, and since action will not follow the recommendations of this report unless they commend themselves as just and timely, those connected with this investigation have felt that the greatest service they could render would be to state their views candidly as they have gathered and presented the facts impartially.

THE SCOPE AND PURPOSE OF THIS INVESTIGATION.

The investigation has been carried on by eight students of irrigation of wide experience and recognized ability, each of whom, with his assistants, has gathered the available facts relative to the character, number, and value of water rights on the stream or streams, and the methods employed in the distribution and use of the water supply included within his particular field. To obtain these facts they searched through many thousand pages of miscellaneous records to find out how much water was claimed, and the purposes for which it was claimed; they overhauled the court dockets to learn what litigation had determined regarding the nature of rights to water and the awards decreed to the different appropriators. Their field investigations included measurements of the flow of streams, size and location of ditches, and the areas of land irrigated, so that their reports show the actual use of water by farmers, and over against it the decreed and claimed volumes of appropriations. Taken together these reports present the irrigation situation in California in a concrete form. While the lessons drawn are based on researches in restricted areas, they apply with equal force to the entire State, because the streams studied are typical ones. Nor are these reports of value to California alone. The principles which should govern the ownership and distribution of rivers are universal in their application, and the experience of irrigators in the San Joaquin and Sacramento valleys is not unlike that of irrigators in other States where similar conditions prevail.

DUTY OF INVESTIGATORS.

The situation demands that those in charge of these studies should be more than reporters. It is their province to interpret the facts gathered and state fearlessly the views held on each important issue involved. It is not expected that their opinions or the measures recommended for adoption will be approved by all. For a half century development has gone on without direction or public control. Every appropriator of water has been left free to claim what he pleased, and as a result there are about as many views regarding the nature of a water right as there are users of the water. Enterprises have been organized on conflicting theories, so that it is now impossible to secure any adjustment which will not affect some one injuriously. This renders it all the more important that those who attempt to unravel these complications should not only study them with open minds, but should state their conclusions without restraint. This privilege will be exercised in this introduction by the writer in giving his personal experiences and impressions, as well as of presenting the conclusions reached by reading the reports of his associates. Some of the views herein expressed are known to be opposed to those of gentlemen whose judgment is held in high regard; but no one ought to object to a candid, temperate statement of convictions, reached after much study and expressed with a desire of promoting the State's development.

PLAN OF THE WORK.

The names of the experts in charge of these investigations and the location of their districts are given on the map of the State, on page 32. Their reports follow, in geographical order, beginning in the north and ending with the most southerly stream studied.

In order to define the limits of the inquiry and secure uniformity in the discussion, a letter of instruction was prepared which outlined the field to be covered. This letter was based largely upon a petition of some of the representative citizens of California, addressed to Dr. A. C. True, Director of the Office of Experiment Stations, and as this investigation really took its form from its statements, the petition, with an extract from the instructions, are both included:

To Dr. A. C. TRUE,
Director, Office of Experiment Stations, U. S. Department of Agriculture:

The undersigned earnestly desire that Mr. Elwood Mead be detailed by the Department to conduct a series of irrigation investigations in California, and trust that you may feel justified in forwarding this request to the honorable Secretary of Agriculture with your approval. We have, of course, ascertained that the proposed detail will not be contrary to Mr. Mead's inclination or his judgment.

We respectfully submit that nowhere in America are there irrigation problems more important, more intricate, or more pressing than in California. Neither are there any whose study would be more greatly instructive. We can offer, we presume, examples of every form of evil which can be found in Anglo-Saxon dealings with water in arid and semiarid districts. Great sums have been lost in irrigation enterprises. Still greater sums are endangered. Water titles are uncertain. The litigation is appalling.

Among the things necessary to be known before we can hope for well-considered legislation upon the conservation and distribution of our waters are the following:

First. The amount of water in the streams.

Second. The duty of water in the different irrigation basins.

Third. The claims upon the water, collated by streams and not by counties as now.

Fourth. The nature of water-right titles.

Fifth. The adjudicated claims upon the waters.

Sixth. The lands now irrigated and susceptible of irrigation.

Seventh. The possible increase of water for beneficial use by storage in each system.

Eighth. The extent to which the irrigable area can be increased by better methods of distribution and use.[1]

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[1] Signed by E. J. Wickson, acting director University of California Experiment Station; J. A. Filcher, manager State board of trade; William Thomas; David Starr Jordan, president Leland Stanford Junior University; E. B. Pond, president San Francisco Savings Union; William Alvord, president Bank of California; Charles H. Gilbert, vice-president California Academy of Sciences; Marsden Manson; T. A. Kirkpatrick, vice-president P. C. M. M. D. Company; E. E. Patten; Grant S. Taggart; Frank Soulé, professor of civil engineering, University of California; Julius Kahn; Victor H. Metcalf; German Savings and Loan Society, by B. A. Becker, president; E. J. Le Breton, president French Savings Bank of San Francisco; California Safe Deposit and Trust Company; W. E. Brown, vice-president Crocker-Woolworth National Bank; Hibernia Savings and Loan Society, by Robert J. Tobin, secretary; M. H. de Young, San Francisco Chronicle; J. M. Gleaves, president California Water and Forest Society; David M. de Long, manager Nevada and Monetta placer mines; R. H. Goodwin, United States deputy mineralogical surveyor; Frank W. Smith; Ernst A. Denicke, president Germania Trust Company; C. E. Grunsky, civil engineer; George C. Perkins; Andrew W. Kiddie, United States deputy mineralogical surveyor.

Instructions to special agents and experts of the United States Department of Agriculture, in the investigations relating to irrigation in California.

GENTLEMEN: The study of the irrigation laws, customs, and conditions of California, in which your services have been secured, is the most comprehensive investigation of these questions yet undertaken in this country. This gives to the facts you are to gather and the reports and conclusions based thereon an exceptional interest.

What you will do in California is being done in other States, and for the purpose of comparing results it is desirable, as far as may be, that all these investigations shall pursue the same general plan, discuss the same general problems, and follow the same order in their treatment. Because of this, and because each of you will act independently in the collection of data and in formulating your conclusions, it is necessary that there be a preliminary understanding regarding both the nature of the subjects to be dealt with, and the general form of your reports thereon. As an aid to such understanding and concert of action, the following suggestions are submitted:

PLAN OF WORK.

On the stream and its tributaries embraced in your field of investigation endeavor to secure all of the facts showing the operation of the present irrigation system. This to include:

First. Abstracts of the records of claims to water, character of those records, including the number of claims, total volume claimed, place where recorded, and the ease or difficulty with which the validity of any claim can be determined.

Second. Rights to water for other purposes than irrigation, viz, mining, power, and domestic use.

Third. The methods by which the amount and character of water rights are determined, accessibility, and completeness of the record showing the nature of the established rights.

Fourth. Character of litigation over water rights, its cost, the causes therefor, its influence on irrigation development, and the principles established by decisions rendered in cases arising on the stream being studied.

Fifth. Rights for storage and underground waters, how acquired, and how they are affected by rights to the surface flow of streams, and how the use of underground waters influences the stream's discharge.

Sixth. Nature of an appropriation of water. Who is regarded as the appropriator—the ditch builder, the owner of the land on which water is used, or is the land itself the appropriator? What is the measure of its amount, the size of the claim, the capacity of the ditch, or the area irrigated?

FIELD INVESTIGATIONS.

Seventh. The collection of the data showing discharge of stream, or measurement of its discharge where no such data can be had. Study of volume of return or seepage water and its availability for being again diverted, and its influence on the value of irrigators' rights.

Eighth. Size, number, location, and capacity of ditches and other distributing works established, and the duty of water obtained.

Ninth. Collection of data showing how water is divided among different ditches from the same stream, how it is distributed among users. Nature of water-right contracts between canal owners and water users, including facts showing what contracts have proven satisfactory, and what ones have given rise to controversy, with the reason therefor. Collection of information showing the value of water for irrigation as shown by the rates paid for its delivery, the methods by which these rates are established, and their justice or objectionable features.

REPORTS.

Tenth. While the facts gathered will largely modify the nature of their presentation, it will greatly aid those who read your conclusions if they deal with the same issues and in the same order. The following scheme is suggested:

(*a*) The foundation of any system of administrative laws is the method of establishing rights to the stream. In your discussion of the results in California, the first question to be considered is whether or not the present method of filing and recording claims to water is satisfactory. If not, what should take its place?

(*b*) Is the present method of adjudicating rights satisfactory? If not, what should replace it?

(c) The present law provides for the appropriation of water for sale, rental, or distribution. Does it provide for its direct appropriation by the user without the intervention of the seller, renter, or distributor? Is there any method by which the owner of a tract of land can acquire directly from the public a right to the water which reclaims that land, as he can now obtain title to the public land itself by means of the desert or homestead laws? If not, should there be legislation to provide for this?

(d) Is the present system of stream control or lack of it, and the dividing of water between the different ditches which divert the common supply satisfactory? If not, what form of administration or control should take its place?

(e) Should there be a State engineer; and if so, what should be his duties?

(f) Should there be a central office of record of claims or titles to water in place of the present separate county records, and what supervision or control should be exercised over rights to be acquired hereafter?

(g) What steps should be taken to secure the fullest conservation and use of water which now runs to waste? The discussion of this question to include State or national control and aid, the legislation needed to define rights to stored water, and to determine who is entitled to the water thus stored.

It is understood that this outline will not touch all of the complex and important problems which your investigations will disclose and with which your reports will have to deal. It is, however, believed to state some of the leading ones with which legislators and users of water are now confronted, not only in California, but in every other Commonwealth.

Sincerely yours,

Elwood Mead,
Irrigation Expert in Charge.

Within the limits thus fixed each of the gentlemen in charge of these investigations has been a law to himself. He has gathered his facts and stated his conclusions without advice or direction from any source. This has resulted in some repetitions which might otherwise have been avoided, but this defect is thought to be outweighed by the advantage gained from a complete and unmodified statement of the views of each of these gentlemen.

REASONS FOR RESTRICTING DISCUSSION OF WATER-RIGHT PROBLEMS TO IRRIGATION.

While this investigation deals primarily with the problems of irrigated agriculture, the fact is not lost sight of that other important industries have a common interest with irrigation in securing laws which will provide for the final establishment of titles to the water used and protect these titles in time of scarcity. At present it is notorious that anyone attempting to utilize the streams of California for any purpose has to add to the ordinary or legitimate risks and expenses of his enterprise a large and continuing outlay for litigation to maintain his right to water. A reform which will render this needless will promote development in other directions as much as in agriculture. A just system of laws will take into account the needs of all interests. This report is restricted to a consideration of the rights and needs of the irrigator because the Congressional appropriation limits the investigation to irrigation, but this must not imply that other rights are not regarded as important or not entitled to impartial recognition. Exactly the reverse is true.

IRRIGATION
SCENES
IFORNIA.

WATER WASTED, SACRAMENTO RIVER.

DREDGER ON SACRAMENTO RIVER.

HEAD OF GAGE CANAL, SANTA ANA RIVER.

CENTRAL CANAL, 60 FT. WIDE ON BOTTOM, NEVER USED.

WINDMILLS NEAR SACRAMENTO.

THE FOLSOM CANAL, AMERICAN RIVER.

HEADGATE OF FOLSOM CANAL.

RESTRAINING DAM, L. TAHOE.

THE PRESENT AND FUTURE OF IRRIGATION IN CALIFORNIA.

It is well to understand at the outset just what irrigation is doing for California and what it can be made to do; how much of the State's prosperity now comes from it and to what extent it will promote future growth. In the States wholly arid this is a simple matter, because there is a clearly drawn line which separates the valuable cultivated land from the worthless desert, and the difference between the two is wholly due to irrigation. In much of California this is not the case. A farmer may irrigate his garden and leave his wheat field to the rain. The forest of windmills around Stockton marks the region of market gardens; beyond these the land is still cultivated, but it is watered, if at all, from the clouds and not by irrigation. On the road from Sacramento to Folsom one passes a constant succession of vineyards and orchards, some irrigated, some not, yet both appear flourishing. In the Santa Clara Valley irrigation did not precede the planting of orchards, but is now slowly being adopted as they come into full bearing. Nevertheless, no State has gained more from the use of rivers in irrigation than California or has more at stake in the extension of this use. The following facts show only in part the reasons for this:

IRRIGATION IN SOUTHERN CALIFORNIA.

In order to realize what irrigation has accomplished in California one must go to the southern part of the State where land, not worth $5 an acre in its original condition, has sold when irrigated and planted to orange trees for $1,700 an acre; where valleys, which were originally deserts or sand and cactus, producing nothing more valuable than stunted grass, and where a whole township would not keep a settler and his family from starving to death if compelled to cultivate it in its natural state, have been transformed into the highest priced and most productive agricultural lands in this country; where water, which formerly ran unused to the ocean, is worth for irrigation alone 10 cents per 1,000 gallons; where $3.50 an inch, and 40 cents an inch extra for its carriage, was paid last year for a twenty-four hours' flow. So valuable is water that $50,000 was recently paid for a perpetual right to 50 inches. This was at wholesale; in small quantities it has sold for more money. The water used last year in the irrigation of 10 acres of orange land cost more than would be required to purchase an equal acreage of the best farming lands of Iowa.

Before streams were diverted and used by irrigators they had no value, and the land on their margin had little. Since this use began the citrus-fruit lands of southern California have brought net annual returns of $200 to $450 an acre, and this year's crop will be worth approximately

$10,000,000,[1] the whole making a record of increase in productive capacity and a creation of agricultural wealth not surpassed in this or any other country.

The rise in land values and the value of the crops grown are not, however, the chief benefits which irrigation has conferred on southern California. A far larger gain has come from the beautiful landscapes created in these deserts by the oases of fruit and foliage, which, with the matchless healthfulness and charm of the climate, have made this section the resort of health and pleasure seekers from all parts of the globe. The climate alone would not have accomplished this. Limited trains on the transcontinental railways from the East would not be crowded if Pasadena looked now as it did when first viewed by the mission fathers, and before they began at San Diego the work which makes this valley now so justly famous. The cities of Los Angeles, Redlands, and San Diego are just as much creations of irrigation as the orange groves which surround them. Whatever may be true of the remainder of the State there is no question that southern California's present prosperity and its future growth depend largely on the distribution and use of its water supply.

IRRIGATION IN NORTHERN CALIFORNIA.

Southern California has demonstrated the value of irrigation. Northern California illustrates its latent possibilities. When one considers the vast area of the Sacramento and San Joaquin valleys, with a surface shaped by nature for the easy spreading of water, with a soil of great fertility and a marvelous climate, there is no doubt that it is to be during the twentieth century a great field of activity, not of the farmer alone, but the engineer, the lawyer, and the student of social and economic questions.

The available water supply of this valley ought to make it the Egypt of the Western Hemisphere. A seven years' record of the flow of Sacramento River, measured above the confluence of this stream with the San Joaquin,[2] shows that during that period 181,553,808 acre-feet of water ran

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[1] Letter from Frank Wiggins, secretary Los Angeles Chamber of Commerce.

[2] The summary given below shows the total discharge of Sacramento River, at Collinsville, for the seven years from 1878 to 1885, inclusive. It is taken from "Physical data and statistics of California," Report of William Ham. Hall, State engineer, 1886:

	Flow, in acre-feet.
1878–79	26,414,302
1879–80	32,205,831
1880–81	31,922,750
1881–82	25,503,305
1882–83	17,633,585
1883–84	29,947,038
1884–85	17,926,997
Mean for the seven years	25,936,258

into San Francisco Bay. The mean annual discharge for these years was nearly 26,000,000 acre-feet. On a duty of water of 2 acre-feet per acre, this would irrigate 13,000,000 acres. It is doubtful, however, if it will require 2 acre-feet of water to irrigate an acre of land in Sacramento Valley. As near as can be determined, the irrigable area of the valley is less than 13,000,000 acres—probably somewhere between 10,000,000 and 12,000,000 acres. Hence the water which runs to waste from the Sacramento Valley, if it could be made available, would more than suffice to irrigate every acre that can be reached by canals from the river or from its tributaries.

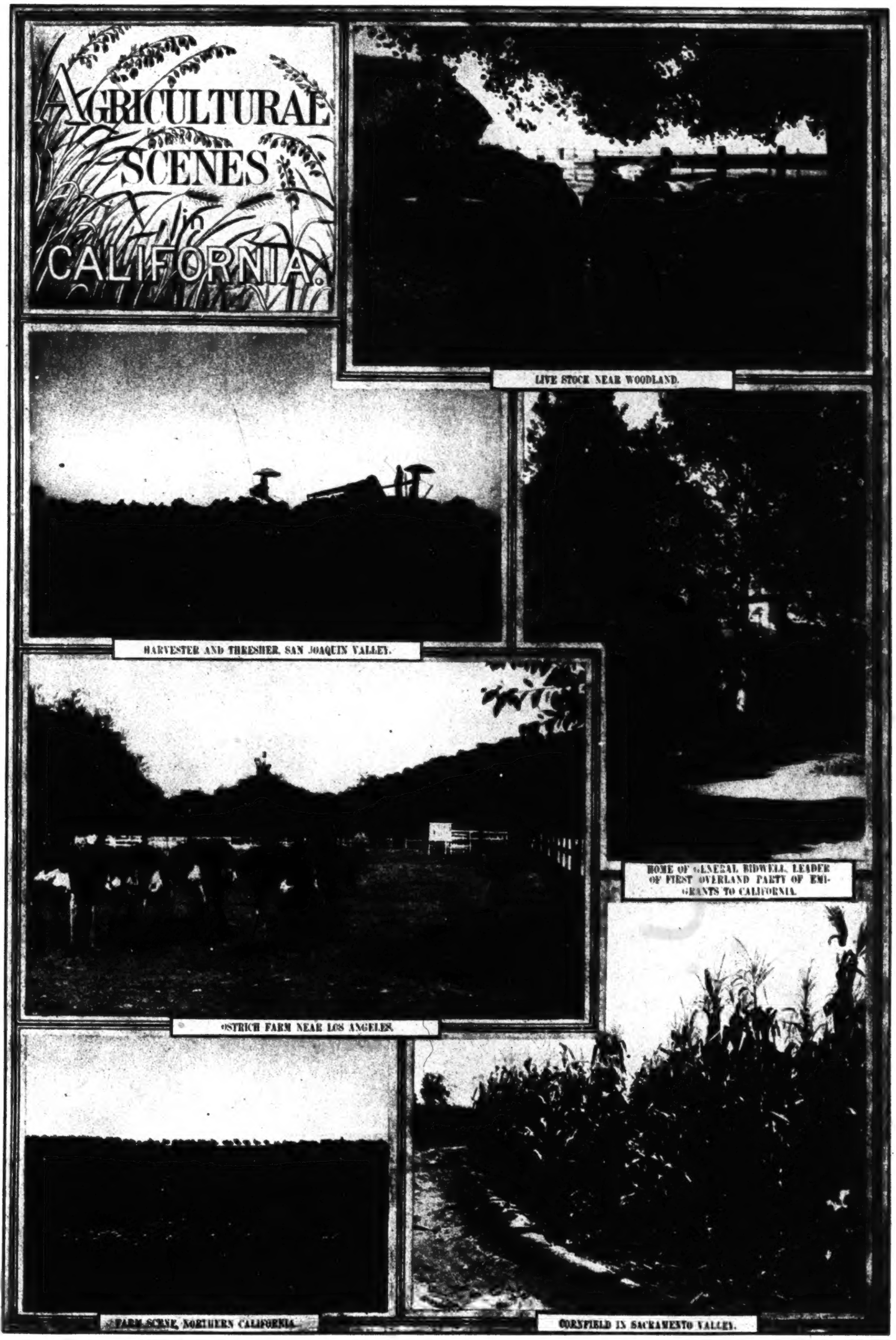
An effort was made to secure the full discharge of San Joaquin River, but without success. From the records of the gagings made on the headwaters and on a number of its tributaries, it seems probable that the total flow of this stream is approximately one-third that of the Sacramento, enough certainly, if conserved and economically used, to irrigate several million acres of land. Not all this water can be used. A large percentage will always run to waste during the winter months; but storage will do much to lessen this, a wise forest policy will aid, and winter irrigation will supplement both. The first step, however, is to use that which now escapes in the summer. The doing of this has hardly begun. In Utah and Colorado a stream like the Sacramento running practically to waste in August would be regarded as next to a crime. Even the ditches already built to divert its flow remain empty. This is not because water for irrigation lacks value. The yearly rental for water supplied by the South Yuba Water Company is $45 an inch. It is evidently worth this much to irrigators, or the price would not be paid. How many acres an inch will irrigate is not known, as reports vary from 3 to 10 acres. Assuming the average to be 5 acres, the water thus used on an acre is worth $9. The land irrigated from the North Fork Ditch, on American River, is worth more than twice as much as the adjacent nonirrigated land. The water from this canal rents for $4 an acre for citrus fruits and $3 an acre for deciduous fruits, with an added charge of $1 an acre for maintaining the irrigation system. The annual water rental for lands seeded to alfalfa is $3 an acre; that for small grain $1 an acre, with, as before, $1 an acre added for maintaining the canal and distributing works. The orange crop from one 10-acre tract in this colony sold last year for over $7,000. There was expended for labor in its cultivation $2,000, and the land itself is valued at $350 an acre. Comparing the financial returns, the number of men employed, the increased productiveness and value of land where irrigated, with the scanty population, diminished fertility, nonresident landlordism, and small yield of wheat where irrigation is not practiced, leaves no question as to what is to be the ultimate use of these rivers. These are not isolated or exceptional examples. Several others equally significant came under my personal notice, while one crop of citrus fruits brought the surprising sum of $1,800 an acre.

DIVERSIFIED FARMING UNDER IRRIGATION.

One of the needs of northern California is more diversified farming. Rotation of crops is one of the most effective means of preserving the fertility of the soil. This result is now secured in fruit growing by the use of fertilizers, but there is a limit to the profitable extension of the acreage devoted to fruits. There is, however, no limit to the profitable extension of agriculture, which makes each home largely self-supporting, where each farmer grows nearly everything he consumes, where his farm supplies him with his poultry, butter, eggs, and meat, where he grows his own hay and has his own pasture and his own orchard and garden. Every acre seeded to alfalfa is a double gain to the State. It stops the impoverishment of the soil and is another step toward making the State wholly independent of the outside world. More than this, it replaces unprofitable cultivation with a kind which pays. How well it pays was shown by numerous reported yields of 11 tons of alfalfa hay per acre, worth $5 per ton.

The report of Professor Soulé states that water rates in the San Joaquin Valley range from $2 to $6 per acre where these rates are fixed by supervisors, and are being contested. This, on a duty of 5 acres to the inch, would mean a value of $10 to $25 per inch. Wasted water is therefore wasted wealth. The loss to the State in productive capacity can scarcely be measured, but the following comparisons with other irrigated countries will show something of its character.

Within a radius of 5 miles in the Sacramento Valley I saw every product of the temperate and semitropical zones which I could call to mind. Apples and oranges grew side by side, as did oak and almond trees. There were olives from the South and cherries from the North. A date palm seemed equally at home with an alfalfa meadow; figs and tokay grapes were apparently as much in their element as the fields of wheat and barley or the rows of Indian corn, some of the stalks of which measured 15 feet in height. All of these things could have been grown on a single acre, and doubtless have been. It is a sinful waste of opportunities to continue using thousands of acres of this land to grow wheat, which steadily impoverishes the soil and robs the pockets of its owners. The irrigable lands of California are no



AGRICULTURAL SCENES in CALIFORNIA.

LIVE STOCK NEAR WOODLAND.

HARVESTER AND THRESHER, SAN JOAQUIN VALLEY.

HOME OF GENERAL BIDWELL, LEADER OF FIRST OVERLAND PARTY OF EMIGRANTS TO CALIFORNIA.

OSTRICH FARM NEAR LOS ANGELES.

FARM SCENE, NORTHERN CALIFORNIA.

CORNFIELD IN SACRAMENTO VALLEY.

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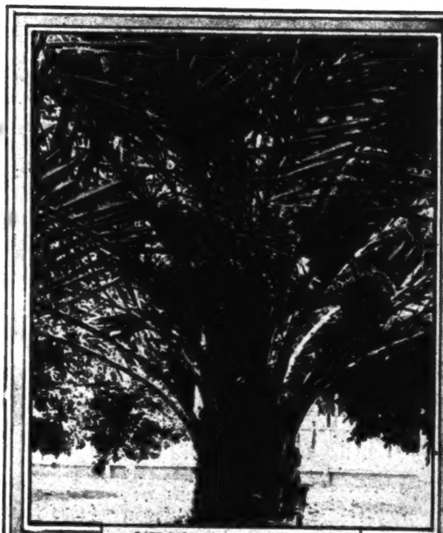
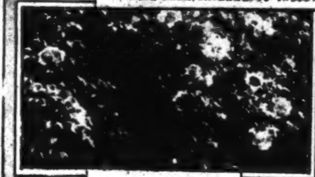
HORTICULTURAL SCENES IN CALIFORNIA



DATE PALM, SACRAMENTO VALLEY.

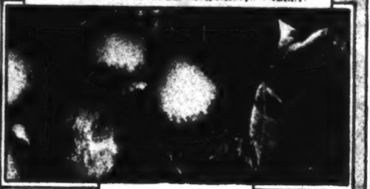
LARGEST OAK IN CALIFORNIA. SPREAD OF BRANCHES 150 FEET. CIRCUMFERENCE OF TRUNK 27 FEET.



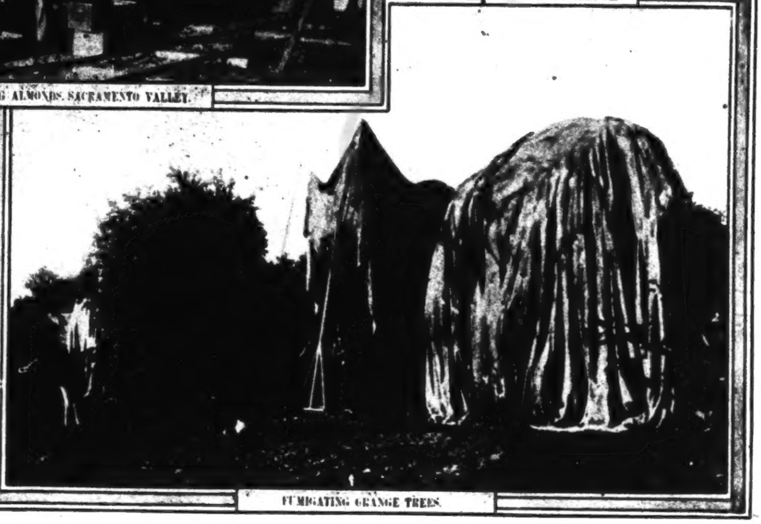
A CALIFORNIA ROSE.

BRANCH OF PRUNE TREE, SACRAMENTO VALLEY.

SHELLING ALMONDS, SACRAMENTO VALLEY.



CALIFORNIA ORANGE.



FUMIGATING ORANGE TREES.

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place for bonanza farms. They are far better suited to the creation of 10 and 20 acre homes.

CALIFORNIA, EGYPT, AND ITALY COMPARED.

There are more acres of irrigable land in the San Joaquin Valley than are now watered in Egypt from the Nile, where agriculture alone supports over 5,000,000 people, maintains a costly government, and pays the interest on a national debt half as large as that of the United States. The area which can be irrigated from the Sacramento is about equal to that irrigated in Italy from the Po. The population of the California Valley is about 20 people to the square mile. In the Italian Valley it is nearly 300 people to the square mile. The irrigated lands along the Nile support 543 persons to the square mile. Such a settlement of the Sacramento Valley would more than double the present population of the State. It is believed that an irrigated square mile in this valley will support as many people in comfort as now live on an equal area in either of the other districts referred to because neither of these surpasses California in the diversity or value of its products or the excellence of its markets.

OBSTACLES TO DEVELOPMENT.

In September last I saw a part of the Sacramento Valley in its most unlovely aspect. One of the trips taken was from Chico to Willows, two towns about 30 miles apart, but the road followed made the distance traveled about 35 miles. We crossed what is potentially one of the most fertile and promising agricultural districts on this continent. For scores of miles the land rises by a gentle and uniform slope from the Sacramento River toward the foothills on either side. Water would flow over every acre of the country traversed without requiring much labor in its direction or skill in the location of lateral ditches. The plains of Lombardy are not better suited to irrigation, nor the soil of the Nile delta more fertile than were these lands originally. For a half century they have been devoted to the unremitting production of cereal crops. Each season the crop has been harvested, the grain shipped away, and the straw burned, and nothing done to replace the plant food withdrawn. A more exhaustive form of agriculture can not be imagined. Although this surprising drain has gone on for fifty years, it can not continue forever. Last year's crop was a failure, and failures will follow in rapid succession hereafter if a change in methods is not soon made. It required only ten years of continuous grain farming at Greeley, Colo., to reduce the average yield from 40 bushels to 12 bushels of wheat per acre, and Greeley is one of the most prosperous farming districts in the West. Less than ten years of scientific rotation of crops restored its original fertility and production. Diversified farming would have equally desirable results in this section of California, but rotation of crops is not possible with rainfall alone. The moisture is neither sufficient in amount nor rightly distributed to permit of this. In 1897, no rain fell at Chico in July and August, and the total rainfall from May to October was less than 1 inch. In 1898, no rain fell in either June, July, or August. In 1899, no rain fell in July or September, and only 0.12 of an inch in August. At Willows, in 1897, no rain fell in either July, August, or September; in 1898, none in July or August; and in 1899 there was again a three-months' period without sensible precipitation. The absence of rainfall during the harvest period is one of the great advantages of California where the needed moisture can be supplied by irrigation. It is likewise one of the greatest obstacles to diversified agriculture where dependence is had on rainfall alone. The natural opportunities of the district traversed are equal to if not greater than those of the country surrounding Riverside, Cal., which has been appropriately designated as the "Garden Spot of America," but a difference in agricultural ideas has produced a corresponding difference in conditions. In the suburbs of both Chico and Willows there were seen attractive homes surrounded by orchards and gardens, but 5 miles would cover the distance required to get beyond the town limits of either place. In the remaining 30 miles only six houses were passed and surrounding these were neither orchards nor gardens. The distressing effects of a two-months' drought and the absence of water to mitigate its influence were only too manifest. These homes were a signal illustration of the truth that a world without turf is a dreary desert. Instead of the refreshing green of an irrigated district, or of a country where there are summer rains, everything was parched, dusty, and lifeless. Practically all of the land was being prepared for small grain. Less than 100 acres of alfalfa were seen and this looked as though it was prepared to surrender the unequal struggle. One-third of the land had been summer fallowed, but much of it was in no condition to be benefited, as the clods had never been pulverized and the fertility of the soil was being burned out by the heat and dryness of the summer sun.

The region visited is one of bonanza farms, the road traversed crossing one of 40,000 acres. A mortgage was the most important result of wheat growing in recent years, and the land is now being sold to satisfy the debts thus created. The boundaries of other large estates were pointed out whose owners were historic figures in the early days of California. In nearly every instance their estates have passed out of their hands and out of the possession of their descendants and are now owned by banks or capitalists in San Francisco, having been taken in payment of loans made to meet the losses incurred in growing small grain. Nor has the change of ownership affected the general result. The present owners of these properties will not rent them to tenants who can not give a satisfactory bank reference, experience having shown this to be a needed precaution. Although equipped with teams and machinery and understanding the California climate and California agriculture, many of these tenants have at the end of the year walked out of the valley, leaving both crop and equipment to pay the debts created by their failure.

CALIFORNIA AND UTAH COMPARED.

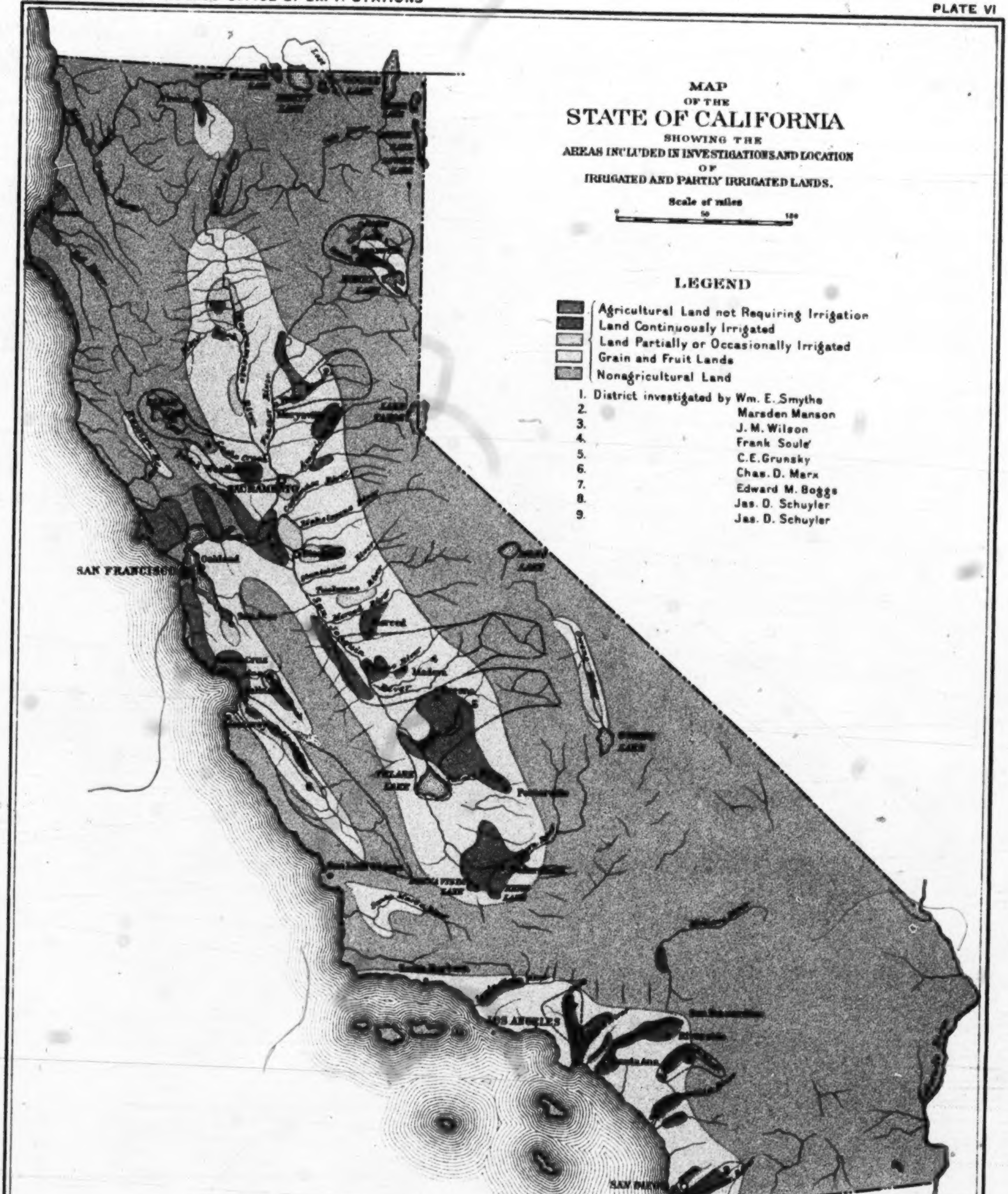
In the 35 miles traversed there were only two schoolhouses. Attending these schools was only one child whose parents owned the land on which they lived. The other pupils were the children of foremen and tenants. The county superintendent told me that at these two schools there were only fifteen children. These conditions of alien landlordism, tenant farming, unoccupied homes and scanty population, in a country so rich in possibilities, show a vital economic defect in methods. The situation here was in such striking contrast with what had been seen in traveling through an irrigated valley in Utah the month before that the difference seems worthy of statement. In a distance of 15 miles, along Cottonwood Creek, Utah, there was not a farm of over 30 acres. The houses and barns on these little farms indicated more comfort and thrift than those of the Sacramento Valley, where the farms are ten times as large. The average population of the Utah district was over 300 people to the square mile; the district traversed in California has less than 10 people to the square mile. The Utah lands range in value from $50 to $150 an acre; the lands of the Glenn estate in the Sacramento Valley are being offered for sale from $10 to $40 an acre. Every natural advantage is in favor of California; but the Utah district is irrigated, the other is not.

OPPOSITION TO IRRIGATION.

The benefits of irrigation seemed so obvious and the necessity for it so great that its absence was at first attributed to lack of opportunity. This, however, is not the case. In repeated interviews with leading citizens of this section it was manifest that the principal reason the land is not irrigated is because of the prejudice against irrigation. The first gentleman talked with in Chico said that irrigation was not needed for either fruit or grain growing. The second said it would bring malaria and attendant ills and destroy the health of the valley. The owner of an irrigation canal said that while he could irrigate, he did so only in a desultory fashion, and did not regard it as beneficial. What I learned of grain growing and what I saw of the fruit trees and the fruit being gathered did not tend to confirm these opinions. While it would be possible to make such wasteful use of water as to injure health, the experience of southern California, Arizona, and New Mexico, where the summers are hotter than in the Sacramento Valley, shows that this result does not follow the careful use of water. The causes for the opposition to irrigation must be looked for elsewhere. They have in part been explained. Others are not obscure.

THE DESIRE FOR LARGE ENTERPRISES.

The bonanza wheat farm and the bonanza orchard were in accord with the spirit which from the first has dominated the industries of California. It is a State of vast enterprises. Men pride themselves on great undertakings and on doing whatever they undertake on a large scale. Wheat can be grown in this way. The man with capacity for organization can look after the growing of 10,000 acres of wheat as easily as 10 acres. It is an industry freed from detail. There is a period of seed time and harvest, and long intervals of complete freedom. It has none of the petty incidents which go with the management of a farm where there are chickens and pigs, where cows are to be milked, and butter and eggs marketed, where each month has its duties, and where there is no time when something does not need attention. This sort of farming comes with high-priced land and a dense population, but it does not appeal to the imagination like the plowing of fields so large that turning a single furrow requires a day's journey, or the cultivation of the ground with steam plows and harrows which require five-mule teams to operate them. The cutting, thrashing, and sacking of grain at a single operation is spectacular as well as effective. In this respect it resembles the range cattle business in its best days. The owner of a range herd was more than a money-maker, he was practically monarch of all he surveyed. The cowboy on horseback was an aristocrat; the irrigator on foot, working through the hot summer days in the mud of irrigated fields, was a groveling wretch. In cowboy land the irrigation ditch has always been regarded with disfavor because it is the badge and symbol of a despised occupation. The same feeling, but in a less degree, has prevailed in the wheat-growing districts of California, and for much the same reason.



MAP OF THE STATE OF CALIFORNIA SHOWING THE AREAS INCLUDED IN INVESTIGATIONS AND LOCATION OF IRRIGATED AND PARTLY IRRIGATED LANDS.

Scale of miles
0
50
100
LEGEND
Agricultural Land not Requiring Irrigation
Land Continuously Irrigated
Land Partially or Occasionally Irrigated
Grain and Fruit Lands
Nonagricultural Land
1. District investigated by Wm. E. Smythe
2. Marsden Manson
3. J. M. Wilson
4. Frank Soulé
5. C.E. Grunsky
6. Chas. D. Marx
7. Edward M. Boggs
8. Jas. D. Schuyler
9. Jas. D. Schuyler
SACRAMENTO
SAN FRANCISCO
Oakland
Merced
Madera
TULARE LAKE
LOS ANGELES
San Bernardino
Riverside
Santa Ana
SAN DIEGO

A. HOEN & CO. BALTIMORE

CONTROVERSIES OVER DISTRICT ENTERPRISES.

Another reason for the prejudice against irrigation in California has been the zeal of its advocates and the mistakes made because of their enthusiasm. If, in connection with the Wright act, there could have been some public control of development which would have restricted the works undertaken to immediate necessities and have deferred the construction of large and costly works until the feasibility and the best methods of construction could have been fully determined, there is little doubt that the area under irrigation in California to-day would be far greater than it is. An illustration of the danger of making haste too rapidly was seen on the road between Chico and Willows. The Central Canal, or what would have been a canal if there had been any water in it, was several times crossed during this ride. It was one of the projects inaugurated under the Wright district law and belongs to the central irrigation district. It was planned to irrigate about 156,000 acres, and estimated to cost $750,000. The canal was begun in the face of active and influential opposition and has been involved in litigation from the outset. Five hundred and seventy-five thousand dollars was expended before work was stopped. Unless the project is carried to completion this large sum of money will be wholly lost, as no portion of the canal is being used or can be used in its present condition. Outside of hostile public opinion there was no reason why this canal should not have been a success. The physical obstacles were not serious; there is an abundance of water, and the lands covered by the canal need irrigation and are well adapted to the easy and efficient distribution of water. That the canal will ultimately be completed seems inevitable, because the increase in value and productive wealth of the land when watered will warrant this The opposition was due in part to the size and cost of the canal. The project was too large. Landowners were frightened at the heavy preliminary outlay. If, instead of this immense canal, works had been begun in a small way with a ditch large enough to water 5,000 acres, and its extension deferred until the profits of irrigation had been demonstrated, the central district would, in my opinion, have been a success. Opposition to the enterprise on the scale undertaken was not wholly unreasonable. Irrigation meant a complete change in agricultural methods. It involved either the breaking up of the large estates, or an immense outlay on the part of their owners to prepare the land for being watered. Many of these owners were not financially able to undertake the latter. The conditions were all favorable to a small project and against a large one. But the fight against this particular project has led many to oppose irrigation in any form. Opposition to the Wright law has caused many to oppose all laws. It is to be hoped that this prejudice and antagonism will soon be ended. A united sentiment is one of the requisites to success.

OBSTACLES PRESENTED BY INADEQUATE WATER LAWS.

Many of those who desire to see the irrigated area extended say they see no way to accomplish it. At Chico it was stated that all the water of that section was now owned; that the Bidwell estate owned Chico Creek; that the Stanford estate owned Butte Creek; that some other estate, whose name has been forgotten, owned Rock Creek, and that any extended use of the Sacramento River would give rise to litigation with the navigation interests. To the inquiry as to how these estates acquired the ownership of the streams named, reply was made that no one understood exactly how a title was established. The owners of these estates were among the first settlers and acquired the rights to water when not much attention was paid to such matters. All those talked with accepted this ownership as established, and were deterred by it from attempting to utilize these streams, where otherwise they would have done so. Because of this the waters of Chico Creek were running to waste, nothing was being done with Butte Creek, and the greater part of Rock Creek was sinking in the sands. Meanwhile the census for 1900 shows that the population of Chico is less than it was ten years ago, that the population of Willows has decreased, and that outside of the irrigated territory there is stagnation in growth and waste of opportunity.

These uncertain but sweeping assertions of speculative ownership of water and the hostility of water users to the recognition of the control this implies have given rise to antagonisms which must in some way be removed. The farmer fears that if he adopts irrigation he will become the serf of the canal company. The capitalist hesitates about irrigation investments for fear of contests with other canals and the reprisals which hostile public sentiment would make possible, because of the fact that the number of canal owners is few while the number of water users is large. The claim of speculative ownership of water and the recognition of this claim in some cases by the courts has been met by the law giving supervisors practically unrestricted power to fix rates. Neither speculative ownership nor unrestricted power over rates can continue without injury to the public, and both should give way to institutions of justice. The time has long passed when makeshift laws and temporary expedients should be resorted to in dealing with this subject. There never was a time when doubtful or controverted policies should have been evaded by the lawmakers and thrust on the courts for settlement. There is as great need for specially qualified officers to determine the amount of the water supply and regulate its distribution as there is to survey the public land and prepare maps by which the different tracts can be identified. There is as great, if not greater, need of a bureau to supervise the establishment of titles to water as there is for land offices to manage the disposal of public land. Why have we recognized the need of one and ignored the other? The answer is to be found in the inherited jurisprudence and prejudice of our race, which for centuries has regarded water as something to be got rid of rather than a resource to be transferred and measured and stored, and finally absorbed in use. That is the status of water in California, where streams are of greater actual value than all the gold in the hills or the oil in the valleys.

The discovery of gold in California and the use of water in irrigation brought the people of that State face to face with two new issues. One of these was the enactment of laws for the control and use of the land which contained placer gold; the other was the creation of laws and customs for the orderly determination of ownership of streams and for their distribution. In their efforts at solving one of these problems, California achieved a satisfactory if not striking success. The code of mining laws provides for a final and definite determination of title to a particular tract of land. The steps through which this evolution was accomplished are of historic and economic interest. They began in a common agreement that a claim should embrace only the area a man could work, and this was fixed as the distance in each direction he could reach with a pick, and made the claim about 8 feet square. There was no attempt to establish ownership of the land itself; the right endured during occupation only. When one individual ceased to work a claim, anyone else could relocate it and take possession. With increase of population and the employment of capital other measures were necessary, and a working code of laws was evolved to meet the changed conditions. This code of laws provided for notices of location, for the recording of these notices, and a simple procedure, before specially qualified officers, to prove compliance with the law, which proof is followed by the issuance by the Government of a patent to the claim which is as stable and certain an evidence of ownership as a patent to a homestead. This law limits the acres which can be filed on. It determines the shape of a full-sized claim and makes provision for properly qualified officers and engineers to carry out the law. Hence every one knows, or can easily learn, how mining rights are acquired and what is the legal status of any particular claim.

The establishment of water laws began in the same manner. At first every user of a stream thought use the essential element, but little thought was given to the establishment of rights equivalent to ownership. When the gold was washed from claims, the ditch which supplied water was abandoned with the claim, and the property right in the stream was probably not thought of further. As the use of streams extended and irrigation and domestic uses were added to mining it became manifest that water rights were to have an enduring value, and provision was made for recording notices of the appropriation of streams. As time went on people began to give more and more attention to the legal forms by which rights to water were recorded, and to regard a compliance with these forms as not only of more importance in securing title than the actual use of the water, but as being the principal consideration in determining ownership. In the evolution of the California water laws none of the safeguards which surround the placer-mining law were incorporated. It places no limit on the volume of water which can be appropriated, it does not make clear whether the extent of the right is to be fixed by the carrying capacity of the ditch or canal, or the needs of the land watered, or independent of either. It is ambiguous as to whether the appropriator owns the water or has only a usufructory right. What was done in effect was to throw open the record books of every county in the State to the entry of any sort of a claim against its most valued property which need or greed might encourage. The results on nine streams are outlined in the reports which follow. These reports do not, however, give an adequate impression of the existing situation. The original plan was to publish an abstract of all these claims. Such an abstract was prepared by a number of the observers. With only a line for each claim, the publication of this list would have doubled the size and cost of this report. Except to show how worse than useless is the law, the list has no value. It gives no indication of the existing or intended use of water. There are three consecutive claims to all the water of San Joaquin River, and the aggregate of all claims in California represents enough moisture to submerge the continent. The humor of the situation is shown in the reports of Mr. Boggs and Professor Soulé. The evil comes in the failure of the law to afford any adequate protection to those who comply with its provisions.

Evil communications corrupt good manners and misleading laws pervert public opinion. Because the water laws of California provide for the legal record of notices which assert rights to all the water of streams men have come to accept the private and even the speculative ownership of water as one of the natural, if not inevitable, incidents of its use in irrigation. It is only human nature for individuals or companies, after they have paid the recording fee for such notice and it has stood unchallenged on the public records for years, to believe they own the water claimed in the notice. The notices given below[1] are taken from the official records of appropriations from the San Joaquin River and tributaries as copied by Professor Soulé. The water records of California contain thousands of such statements.

No matter what courts may declare or reformers urge, so long as the sort of procedure which the San Joaquin record illustrates is continued men who file claims will regard speculative ownership of water as authorized by the law of appropriation in California. In talking of this an intelligent, fair-minded ditch owner last year voiced the prevailing opinion in the following words: "I filed on this water, and it is mine to do with as I please. I can run it into a gopher hole if I want to. I can sell it, or rent it to my neighbors, or I can waste it in the sand, and neither the Government nor State has any right to object." The question before the people of California is, "Is or is not this the doctrine of water ownership which ought to prevail? If not, what is to take its place?" No matter what policy is adopted, it ought to be definite and all rights made to conform to its conditions. Of the policy of doing nothing, deciding nothing, there has been enough. Something more is now required. This is a comprehensive code of laws which will be as just and effective as those of Italy, or Canada, or Wyoming, which will represent the knowledge of the twentieth century rather than a blind adherence to the conditions of fifty years ago. It is a significant fact that the best irrigation laws do not permit of the unrestricted filing of claims. In fact they do not permit water to be appropriated. Italy issues licenses to take water; other countries treat rights to use streams as franchises. In

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[1] Know all men whom it may concern that I, ——— ———, have this 8th day of October, 1877, appropriated all the water of the west and east forks of Willow Creek, together with the entire amount of water flowing down Willow Creek, and emptying into the north fork of the San Joaquin River, in Crane Valley * * * to be done by ditch and flume of 3 feet wide by 2 feet deep.

Notice is hereby given that ——— ——— claim by priority of location, use, and appropriation the first right to the use of water running in the San Joaquin River for the purpose of irrigation, navigation, and supplying towns and villages with said water, and also for motive and mining purposes. Said use and appropriation to be exercised as circumstances may require, either by using said water as it naturally flows in said river, or diverting the same, or increasing its volume in such mode as may be deemed requisite.

Notice.—I, ——— ———, do this day locate, appropriate, and claim the water now flowing and hereafter to flow in Big Creek from a point at and above where this notice is posted on said stream, to the extent of 100,000 inches, measured under a 4-inch pressure. * * * I intend to divert said water by ditches of the capacity of said 100,000 inches and by flumes of the same capacity.

Wyoming anyone desiring to use water must obtain a permit to use it from the State. To have regulation precede the asserted individual ownership or control has two advantages. It enables everyone to understand from the outset just what one's rights are and commits the Government to the protection of the rights officially indorsed.

APPROPRIATIONS FOR SALE, RENTAL, OR DISTRIBUTION.

It is the belief of the writer that rights to water should be for use only; that appropriations for irrigation purposes should not belong to either a canal company or an owner of land, but should attach to the land irrigated and be inseparable therefrom. Where this doctrine prevails, canals and ditches become, like railroads, great semipublic utilities, means of conveyance of a public commodity, their owners entitled to adequate compensation for services rendered, but having no ownership in the property distributed. Believing this, the law which permits appropriations of water for sale, rental, or distribution is regarded as unwise and dangerous. It accomplishes no good result that the attachment of appropriations to the land irrigated would not promote. On the other hand, permitting individuals or corporations to appropriate water which irrigators must have in order to live, gives rise to antagonisms and makes possible grave abuses, the nature of which is shown over and over again in the reports which follow and which has been characterized in the following striking statement made by William E. Smythe:

> If we admit the theory that water flowing from the melting snows and gathered in lake and stream is a private commodity belonging to him who first appropriates it, regardless of the use for which he designs it, we have all the conditions for a hateful economic servitude. Next to bottling the air and sunshine no monopoly of natural resources would be fraught with more possibilities of abuse than the attempt to make merchandise of water in an arid land.

The doctrine of private or speculative ownership of water has not thus far benefited those who have appropriated water to rent or sell. It has made them trustees or agents for users and thrust on them all the expense of fighting rival appropriators in the courts for control of the supply. It makes every user of water feel that he is the victim of an unjust discrimination because, while the appropriator gets the water from the stream as a free grant, he has to pay for the share he enjoys.

The relative merits of laws which attach appropriations to the land and those which, like California, make the ditch or canal owner the appropriator is not a matter of theory or conjecture. In every country where rights attach to the land irrigators are prosperous and peace prevails. In countries where control of water and ownership of land are separated controversies and abuses abound. There is no exception. The situation in Wyoming as contrasted with that in California shows that the arid West is not destined to furnish one. If human experience has any value we ought to heed its lessons, and the following extracts from official reports dealing with this issue are so pertinent as to be worthy of insertion:

> A recognition of the danger of allowing water to be monopolized without regard to the land has led a commission appointed to inquire into Californian irrigation to declare that "as a matter of public policy it is desirable that the land and water be joined never to be cut asunder; that the farmers should enjoy in perpetuity the use of the water necessary for the irrigation of their respective lands; that when the land is sold the right to water shall also be sold with it, and that neither shall be sold separately.—Australian Report on American Irrigation.
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> Italian experience, French experience, and Spanish experience all go to show that the interests to be studied in relation to irrigation schemes are so many and so various, and so intimately bound up with the public welfare, that State control is imperatively necessary, and that for the protection of its citizens no monopoly can be permitted which would separate property in water from property in the land to which it is applied.—Fourth Progress Report, Royal Commission on Water Supply, Victoria, Australia.
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> European experience shows * * * that where waters belonging to the State are farmed and relet by private individuals water rights are a constant source of gross injustice and endless litigation. The consequence of these interminable vexations is that the poorer or more peaceably disposed landholder is obliged to sell his possessions to a richer or more litigious proprietor, and the whole district gradually passes into the hands of a single holder.—G. P. Marsh, formerly United States minister to Italy.
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> The ancient principles of common law applying to the use of natural streams, so wise and equitable in a humid region, would, if applied to the arid region, practically prohibit the growth of its most important industries. Thus it is that a custom is springing up in the arid region which may or may not have color of authority in statutory or common law; on this I do not wish to express an opinion, but certain it is that water rights are practically being severed from the natural channels of the streams, and this must be done. In the change it is to be feared that water rights will in many cases be separated from all land rights as the system is now forming. If this fear is not groundless, to the extent that such a separation is secured water will become a property independent of the land, and this property will be gradually absorbed by a few. Monopolies of water will be secured, and the whole agriculture of the country will be tributary thereto—a condition of affairs which an American citizen having in view the interests of the largest number of people can not contemplate with favor.
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> Practically in that country the right to water is acquired by priority of utilization, and this is as it should be from the necessities of the country. But two important qualifications are needed. The user right should attach to the land where used, not to the individual or company constructing the canals by which it is used. The right to the water should inhere in the land where it is used; the priority of usage should secure the right. But this needs some slight modification. A farmer settling on a small tract, to be redeemed by irrigation, should be given a reasonable length of time in which to secure his water right by utilization, that he may secure it by his own labor, either directly by constructing the waterways himself or indirectly by cooperating with his neighbors in constructing systems of waterways. Without this provision there is little inducement for poor men to commence farming operations, and men of ready capital only will engage in such enterprises. * * * *The right to use water should inhere in the land to be irrigated, and water rights should go with land titles.*—Land of the Arid Region, by J. W. Powell.

The European country which most nearly resembles California is southern Spain. The rainfall in Spain is less than that of California, and irrigation is indispensable. Spanish water laws are the outcome of a thousand years' experience, in which local customs widely different in character have long operated side by side in different districts of the same province. The small size and contiguity of these districts makes it certain that climate and soil have nothing to do with the difference in the prosperity observed among the farmers. The situation there resembles what would prevail in California if each county of the State had a different code of water laws and a different doctrine regarding water rights. There has been time enough to work out to a final result the influence of the different doctrines of water ownership. In Valencia, the most beautiful and prosperous section of Spain, irrigated agriculture dates back to the Moors. Water rights are founded on customs which are older than records. Water and land are inseparable. Every writer who has visited Valencia is of the opinion that the thrift, the skill, and the success shown by farmers comes from the peace and security which go with the control of both elements of production in an arid region—water and land. In the same province the results of the separate ownership of water and land are as completely manifest. In the district of Elche water was originally controlled by the landowners, but land and water were not made inseparable. Gradually water rights were bought up by outsiders. Now the farmer buys water from these owners of streams just as he does fertilizers. The water tolls have been raised, farmers impoverished, and all progress and prosperity banished. In the province of Murcia water is attached to the land and farmers are prosperous. In Lorca land and water are separated, and the result, says a recent report, is "large profits for the water owner, poor farmers, and languishing agriculture."

Which of these two policies does California propose to adhere to? The recognition of property rights in water and their separation from land can lead to but one result: Development of irrigation will be corporate and great aggregations of capital will control the water resources of the West. Thus far court decisions in California have been conflicting. As already stated, the policy adopted ought not to be chosen in the light of what is, but in the light of what ought to be. The experience of Europe shows that the ownership of water apart from land can not prevail without creating grave abuses, and, no matter what the trouble or cost of getting on a proper basis may be, it ought to be done. Experience in the arid States of this country has also shown that separate ownership of water and land results in contests and expensive lawsuits, while union of land and water greatly lessens these evils or ends them entirely. Hence it can not be public interest but private selfishness which rejects this doctrine.

In Wyoming and Nebraska the true principle has already been adopted by the State boards of control and put into practice with the best results.

If it can be maintained and speedily extended to California, it will not only relieve this State of many existing complications but will put her irrigation system in accord with the best thought and experience of the time.

These views are based on eighteen years' personal contact with users of water in States where ditch owners are the water owners and in States where water rights are inseparable from the land. The result of that experience shows that attaching water to land makes for peace; attaching it to the ditch owner makes for war. So long as ditch owners are the appropriators they have to maintain a dual conflict. They must strive with other ditch owners for control of the stream and with water users over the quantity and price of the water delivered. On the other hand, where ditches are made carriers of water and appropriations attached to the land, the expense of the struggle over a fair division of streams does not fall, as it does in California, solely on the owners of canals. It falls on the landowners, and it has not taken long in the States where users have to bear the cost and loss of an unfair division to end this expense and uncertainty by putting streams under State control. Where appropriations attach to the land ditch owners have no responsibility except to deliver what comes to the headgate. For this service they are entitled to fair compensation, and come nearer receiving it than do the ditch and water owners of California, where rates are fixed by a tribunal and a procedure which makes the practical confiscation of investments more than a possibility. The doctrine of private ownership of water has not thus far in this country worked to the benefit of the ditch owner. On the contrary, it has been the greatest evil with which he has had to contend. It has been a potent source of hostile public sentiment; it has led to retributive legislation, of which the laws for fixing water rates in California and Colorado are signal illustrations. What may be the opportunities of this policy in the future as water becomes scarcer and more valuable it is impossible to say, but the dangers to ditch companies are fully as pronounced as are the possibilities of increased profit. Whatever views may be held regarding this matter, there is one thing about which there can be no dispute, and that is that the present uncertainty should be ended. So long as it continues California is in no condition to either solicit development by private capital or aid through State or national appropriations. Private control of streams is infinitely to be preferred to no control. Taking the most extreme view of speculative rights which would give to each of these recorded notices its face value, it would at least give investors a basis on which to build canals and extend the distribution of streams which now run to waste. On the other hand, if rights are to be measured by actual use, a knowledge of the quantity of water which now runs to the sea will serve as a guide to the opportunities for new and later appropriations. But so long as the nature of an appropriation is unsettled, so long will records of claims to water be a constant temptation to revive old projects and vitalize dead rights, with a resulting increase in litigation and controversy over streams.

RIPARIAN RIGHTS.

The perplexities of water users have been increased in California by the recognition of riparian rights, which give to any landowner along the margin of a stream the right to have its water flow past his land unimpaired in quality and undiminished in volume, or, at least, it renders uncertain the extent to which the volume may be diminished. This law is borrowed from rainy, foggy England, where it has a climatic fitness, because civilization in that country began with the draining of bogs and marshes, and the chief utility of rivers is to drain the water off the land; but the doctrine has no place in a country where all the water streams carry should be diverted and used. It has been abrogated in all the States wholly within the arid region. Not only has the doctrine been abrogated in Colorado, Wyoming, Montana, Idaho, Utah, Nevada, and the Territories of Arizona and New Mexico, but in the provinces of Victoria and New South Wales in Australia and the Northwest Territories of Canada. All these provinces are colonies of Great Britain, where regard for the time-honored precedents of the mother country would supposedly be greater than in the United States. The abrogation of this doctrine in these provinces was not made until after a careful study of irrigation in both Europe and America. The commissioner who made the investigation for the Canadian government, in a recent paper describing the Canadian code of irrigation laws, says:[1] "It recognizes as a foundation principle that only by the absolute repeal of the common law of riparian rights can the use of water for irrigation be successfully introduced." The same view is held in the States and Territories of this country where the doctrine has been set aside. The supreme court of Utah, in one of the earliest decisions on this question, used the following argument in support of its action:

> Riparian rights have never been recognized in this Territory, or in any State or Territory where irrigation is necessary, for the appropriation of water for the purpose of irrigation is entirely and unavoidably in conflict with the common-law doctrine of riparian proprietorship. If that had been

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[1] J. S. Dennis, deputy commissioner of public works, Canada. U. S. Dept. of Agr., Office of Experiment Stations Bul. 86.

recognized and applied in this Territory, it would still be a desert; for a man owning 10 acres of land on a stream of water capable of irrigating 1,000 acres of land or more near its mouth could prevent the settlement of all the land above him; for at common law the riparian proprietor is entitled to have the water flow in quantity and quality past his land as it was wont to do when he acquired title thereto, and this right is utterly irreconcilable with the use of water for irrigation. The legislature of this Territory has always ignored this claim of riparian proprietors, and the practice and usages of the inhabitants have never considered it applicable and have never regarded it.—Stowell *v.* Johnson, 26 Pac. Rep., 290.

In California no definite laws establishing or abrogating the doctrine as applied to irrigation have been passed, and, as a result of this and of the further fact that the laws of the State are in conflict with the constitution, the supreme court of the State was compelled to practically enter the field of legislation when called upon to decide the case of Lux *v.* Haggin. (69 Cal., 255.) In this case Lux represented the riparian doctrine and Haggin the right to use streams in irrigation. It so happened that this case arose in a section of the State where crops can be grown without irrigation, and so the recognition of the doctrine did not necessarily mean, as has been contended by the attorneys, that the settlers who were diverting water would have to abandon their homes if deprived of it, as they would have had to do in Utah and even in some sections of California.

The fact that in a preceding case the same issues had been presented to the court and the doctrine of riparian rights set aside, and that in this case three out of seven judges believed it ought to be set aside, gives reason for an interesting conjecture as to what the result might have been if this historic case had involved orange lands where irrigation is a necessity instead of wheat lands where it has not been so regarded.

This misgiving as to whether a strict construction of the law required a decision so contrary to climatic necessities and which has proven so injurious to development does not in any way reflect upon the court. Its duty was to interpret the law as it existed regardless of consequences, and then to enforce its policy with equal disregard of results. This, however, is not what has happened. The decision was really a compromise. While it refuses the right to appropriate or divert water to irrigate nonriparian land, it allows it to be used on riparian land.[1] The right to use streams accorded riparian proprietors has been so liberally construed in subsequent decisions that it now resembles more nearly that claimed by appropriators than the riparian doctrine as originally understood. The economic import of the decision has not been what the counsel for appropriators or the three dissenting judges believed it would be, as is shown by the following extracts:

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[1] "The right of the riparian proprietors to a reasonable use of the stream for the purposes of irrigation is recognized in many of the California cases, etc." (69 Cal., 409.)

> The interests involved are of such magnitude, not only as between the parties themselves, but also as to thousands of others, and the result reached so disastrous to the defendants, so destructive to the vast and beneficial improvements made by them in good faith and in the belief that the same law as to those matters applied both to the State and Government lands in California, so disastrous to the people of a large part of California, and so destructive of all those great interests which have grown up under the irrigation system based upon the doctrine of appropriation to beneficial uses, that we firmly believe your honors will wish, even if in the end you feel compelled to adhere to the views already expressed, to do so only after you have permitted argument to be exhausted upon the subject and have received all the light which the profession can give. No matter how onerous and pressing the duties which devolve upon your honors, there is, we submit, before you no question or business which can compare in public interest to the inquiry whether the decree shall stand which condemns to absolute barrenness the thousands of acres of land reclaimed from the desert by the vast expenditures of the defendants here and now a garden of productiveness and beauty, in obedience to the law of another country, based upon its customs, and arising under conditions the most diverse from ours; whether, in obedience to that law, a large part of this State, after a progress almost unparalleled and improvements made at incalculable cost of labor and treasure, is to be condemned to return to sterility and unproductiveness; whether, in obedience to that law, the wheel of progress is to be turned back and the present prosperity of thousands changed into ruin and poverty that a few men who happen to own land on the banks below may enjoy the pleasure of seeing the stream flow as it was accustomed to flow. Your honors will not, we are sure, forget that this decree, if it is to stand, not only overthrows the progress of the past, but puts a perpetual bar upon future progress and development. For if the purchase of the smallest subdivision of land on a stream below gives riparian rights, overthrows the settled policy of the State, and changes its laws, no man will venture to expend a dollar in turning water, which is the lifeblood of California, upon her comparatively waterless land.—Extract from argument in favor of rehearing by John Garber, of Garber, Thornton & Bishop.
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> The doctrine that the water of a stream must continue to flow in its natural course undiminished in quantity, has been so far modified in States with the climatic conditions of Massachusetts and Illinois as to permit the diversion of water for the purposes of irrigation where the quantity of the stream is necessarily diminished by at least the quantity absorbed in the irrigation of the land upon which it is put. Especially should this be so in California, where in a great part of the State water is its very lifeblood. Every practical man must know that, with the dry atmosphere and porous soils of those sections requiring irrigation, but little, if any of the water diverted and used in irrigation is or can be returned to the stream from which it is taken. To establish, therefore, as the law of this State, that the water of a water course must flow on in its natural channel undiminished in quantity would in effect be to convert the fertile fields, gardens, orchards, and vineyards in many and great sections of the State into waste and desert places. Such a rule is inapplicable to the conditions of things existing here. The common law is supposed and has been said to be the perfection of human reason, but it would be the very reverse of this to hold that the waters of the streams of California must continue to flow in their natural channels until they sink into the sand or waste themselves in the sea, while orchards, vineyards, and growing crops of immense if not incalculable value perish from thirst.—Extract from dissenting opinion of Justice Erskine M. Ross.

If the decision of the California supreme court had meant what the three dissenting justices thought it meant, it would have practically ended the use of water in irrigation so far as California is concerned. That this result did not follow indicates that the riparian doctrine of California, as established in Lux *v.* Haggin, is something entirely different from the common-law riparian doctrine as understood elsewhere. Not only do the actual conditions of irrigation and the practices of irrigators in California indicate this difference, but it is recognized by law writers. In a recent discussion of this subject, Hon. John D. Works, ex justice of the supreme court of California, has clearly and cogently portrayed the existing situation. He says (the italics being ours):[1]

> The majority opinion (in Lux *v.* Haggin) sustained the contention that the common law must prevail, and that the court must not be swerved from its enforcement by the plea of differing conditions and injurious consequences. But the court, while not overruling this case, has in numerous subsequent cases departed from it, and the court in that and later cases has done precisely what it was then held could not be done: allowed the necessity for some different rule of right, as between the riparian owners themselves and between them and the appropriator, to prevail over the law as it was then declared to be.
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> But, strangely enough, while the main question in that case was whether the common-law right of a riparian owner should be recognized as existing at all in this State or not, and the right was upheld, manifestly, only because the majority of the court felt constrained to that conclusion by strict rules of law, that and later cases, or some of them, *have extended the right of a riparian owner far beyond that vested in him at common law, and has thus, in a measure, if not entirely subverted and destroyed the common-law riparian right.*—Pp. 11–12.
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> As the law of this State stands to-day, the common law of riparian rights is in force. *But those rights are so entirely opposed to the best interests of the State that they are being but little regarded in the actual distribution and use of water*, and therefore the conclusion of the supreme court that they must be respected as existing rights in this State has not been as harmful as was at first anticipated. It is believed that one of the strongest reasons for this is that the owners of riparian rights have found that in order to make their rights of any value, for purposes of irrigation, they must become appropriators of the water. And the supreme court has practically nullified the common-law right to water by recognizing and making part of it the right of appropriation for irrigation. The practical effect of it really is to give the owner on the stream a preferred right to appropriate so much of its waters as he may reasonably need for the irrigation of his riparian lands.—Harris *v.* Harrison, 93 Cal., 676.
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> And while the court has enlarged the right of the riparian owner by allowing the diversion and use of the waters of the stream for irrigation it has, on the other hand, limited his right by holding that he can not complain of an appropriation of a part of the stream above him when the water diverted would not be used by him.—Modoc L. and L. S. Co. *v.* Booth, 102 Cal., 151, 156.
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> But his injury by an unlawful diversion can not be held to be inconsiderable, because it is incapable of ascertainment or can not be measured in damages.—Heilbron *v.* Canal Co., 75 Cal., 426.
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> This is, of course, an infringement upon the common-law riparian right of the landowner, which entitles him to the flow of the entire stream undiminished in quantity. Under the common-law doctrine, the question whether he could use the water in no way affected or limited his right. It was simply a giving way by the supreme court to the necessity, growing out of the prevailing conditions in this State, to curtail the common-law right of the riparian owner in order to conserve the water of the State and allow its more extended use.
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> But the very same thing that would justify the court in enacting and enforcing this limitation of the common-law right would have justified it equally in holding, in the first instance, that the common-law right was not applicable to the conditions prevailing in this State, and that the common law respecting it was never in force here.
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> The right of a riparian owner, as thus expanded and limited to suit the exigencies of the situation by the supreme court, is, according to the decided cases in this State, the subject of sale and transfer by him, and may be lost by grant, condemnation, or prescription.—Gould *v.* Stafford, 91 Cal., 146. Alta Land, etc., Co. *v.* Hancock, 85 Cal., 219. Sprague *v.* Heard, 90 Cal., 221.
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> But this, again, is wholly inconsistent with the common-law right which is a part of the land to which it is annexed. Of course he could grant or convey his right with the land of which it is a part,

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[1] Works on Irrigation, pp. 11–25.

> but not otherwise, because when severed from the land it is no longer a riparian right, but that right is wholly destroyed. Therefore, it is certainly an error to say that a riparian right may be conveyed separate from the land. The party to whom the conveyance is made may obtain the right to the use of the water, but it is no longer a riparian right.—Pp. 23-25.

If the conclusions of Judge Works, quoted above, are correct, and they are quoted because believed to be, the riparian rights recognized and established by the courts of California are a new creation, since they have no foundation in statute law and are not in accord with the common law. As these rights, if maintained, will in time control the greater part of the water supply of the State and shape the development and character of an industry on which the welfare of generations yet unborn will depend, it becomes a matter of more than usual economic interest to determine definitely their limitations and character. To do this from a study of existing conditions would require more than a finite intellect. Among the contradictions and uncertainties which they present to students of the subject, and to those wishing to make use of the water supply, are the following:

The doctrine of appropriation and the common-law doctrine of riparian rights are directly antagonistic and can not be reconciled, yet both are a part of the California irrigation system. One exists by virtue of a statute and the other through court decision. How they operate together is illustrated by the conditions in the eight districts included in this investigation. The discussions of Mr. Schuyler of the situation in southern California, and of all the investigators in the Sacramento and San Joaquin valleys, portray the uncertainties and dangers which now beset users of water. These reports show that appropriators claim over 100,000,000 inches, which is more than the combined discharges of the streams, and leaves nothing for the riparian proprietors. The latter, on the other hand, claim a preferred right to use, sell, or lease the entire flow of these streams, and in some instances where they have not cared to do either they have successfully prevented the use of these streams by others. No one, whether an appropriator or riparian proprietor, knows definitely how much water he is entitled to, nor how soon he may have to defend his rights in a long and costly lawsuit.

If the waters of California streams were required to flow in their natural channels substantially undiminished in quantity, as would be the case under some definitions of the common-law doctrine, there would be no uncertainty regarding what are riparian lands. They would be those lands immediately contiguous to the stream. But when this doctrine is so modified as to permit water to be taken away from the stream for the irrigation of land more or less remote from the natural channel, and when in practice streams are being absorbed by such diversions, there is need of some standard by which the location and area of riparian lands and of the volume of riparian diversions can be defined. Are all irrigable lands to be regarded as riparian lands; if so, where does the doctrine differ from the laws governing appropriations of water? Is the owner of a section of land having a few hundred feet frontage on a stream entitled to irrigate the entire section as riparian lands; and if he disposes of a quarter section which does not touch the stream to a nonriparian landowner does the land sold cease to be riparian land and lose its right to water for irrigation? We have not been able to find any decision which specifically answers these inquiries.

A riparian proprietor in California has been held to possess a right in the stream which he can sell, rent, or lease.[1] In the absence of a definite determination of the volume of water to which each riparian proprietor is entitled the volume sold depends largely on the demand for water and the price which will be paid for it. In some cases rights are asserted to water enough to irrigate all the lands owned by the riparian proprietor and, in addition, to all the water that he can dispose of to his nonriparian neighbors.

These investigations have shown that riparian proprietors have not only claimed a right to take water for nonriparian lands, but also to exercise this right in a wholly arbitrary fashion. The report of Mr. Wilson (p. 174) serves to show how water is furnished or withheld at the will or caprice of riparian proprietors.

In California riparian rights may be disposed of by sale. This is different from the disposal of water before referred to. As Judge Works has stated, the purchaser of a right does not hold it as a riparian proprietor. The sale entirely changes its character. So far as we are able to determine, the purchaser of such a right would hold it as a purely speculative property. By extending his purchases he could acquire the absolute control of the entire waters of a river. And it is the assertion of a right of this character that forms the basis of the principal controversy discussed in the report of Mr. Wilson.

Wherever a riparian proprietor objects to the use of water above him, only litigation can determine whether or not his objection is justified. A speculative purchaser can, by the purchase of the rights of the riparian proprietors, acquire such control of a stream as to be a menace to actual users, even if he does not levy tribute upon them. The justices who considered this matter in Lux *v.* Haggin were confronted by the fact that appropriators were claiming all the water in the State, not because they needed it or intended to use it, but because they proposed to rent or sell it to users. That they regarded the abuse of appropriations as serious an evil as the restriction of the riparian doctrine seems clear from the following extract from the decision:

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[1] Gould *v.* Stafford (91 Cal., 146); Sprague *v.* Heard (90 Cal., 221); Swift *v.* Goodrich (70 Cal., 103).

> If the law is settled, we can not override the established rule to secure some conjectural advantage to a greater number. If, however, we were permitted to do this, the inquiry would still remain whether the recognition of a doctrine of appropriation (such as is contended for by respondent) would secure the greatest good to the greatest number. Observe, if that be the true rule, the appropriator does not necessarily act as the agent of the State, employing the power of eminent domain for the benefit of the public, but by his appropriation makes the running water his own, subject only to the trust that he shall employ it for some useful purpose. It would hardly be contended that while he continues to use it for a useful purpose a statute would be valid which should take it from him without indemnification under a pretext of regulating the "common use" of the water more profitably or of providing for its distribution so as to benefit a greater number of persons. He would have a vested right to the use of the water, although the riparian proprietors would have none. If, indeed, one who has appropriated the water of a stream since the adoption of the present constitution has appropriated it "for sale, rental, or distribution" to others, the rates he may charge consumers must be fixed by local authority. (Const., art. 14, sec. 1.) But if he shall consume the water himself, one may thus, for his own benefit, arbitrarily deprive many of an advantage which, whether technically private property or not, is of great value, and thus secure to himself that which by every definition is a species of private property in him. Riparian lands are irrigated naturally by the waters percolating through the soil and dissolving its fertilizing properties. This is sufficiently apparent from the consequences which ordinarily follow from a continual cessation of the flow of a stream. If, in accordance with the law, such lands may be deprived of the natural irrigation without compensation to the owners, we must so hold; but we fail to discover the principles of "public policy," which are of themselves of paramount authority, and demand that the law shall be so declared. In our opinion it does not require a prophetic vision to anticipate that the adoption of the rule, so called, of "appropriation" would result in time in a monopoly of all the waters of the State by comparatively few individuals, or combinations of individuals controlling aggregated capital, who could either apply the water to purposes useful to themselves, or sell it to those from whom they had taken it away, as well as to others. Whether the fact that the power of fixing rates would be in the supervisors, etc., would be a sufficient guaranty against overcharges would remain to be tested by experience. Whatever the rule laid down, a monopoly or concentration of the waters in a few hands may occur in the future. But surely it is not requiring too much to demand that the owners of lands shall be compensated for the natural advantages of which they are to be deprived. (69 Cal., 308-310.)

The fear above expressed is believed to be well founded. The establishment of riparian rights does not, however, provide a remedy. To do that water should be attached to all the lands on which used, instead of simply those lands past which it flows. The germ of natural justice is in the riparian doctrine, but in arid lands it needs to be expanded to permit of the largest use of the stream.

Giving to the lands abutting the river control of its waters when the necessity for irrigation extends to all the lands in its valley involves a complete disregard of climatic necessities, and is not warranted by any element of natural justice. The water which fills the stream does not come from lands owned by riparian proprietors. Its storehouse is the distant mountains. The snows and rains fall as a rule on public land, and are as much the property of the nonriparian as of the riparian landowner. They belong also to the Government, which has no direct interest in either class of lands, but which is vitally concerned in securing the largest and best use of the State's resources. The preservation of the forests upon which the perennial character of the water supply depends is not looked after by the riparian proprietors alone. It would be an incalculable gain to the State if all the rights to water could be measured by the same test—that of actual beneficial use. But if this can not be done then riparian rights should be made inseparable from riparian lands. If it is good law and good policy to give the present owner of riparian lands a right in the stream bordering his land, it is equally good law and good policy to protect the man who may own the same land fifty years hence in the same right. This can not be done if riparian rights are held to be transferable. The recognition of the power to sell these rights is contrary to the teachings of experience in either arid or humid countries. These sales in California have already helped to create monopolies in water, and made it an instrument of speculative extortion not permitted by the worst of the State laws where rights are acquired by appropriation alone. In any event every individual right should be defined in some way, and its volume, or the land to which it attaches, determined by some systematic procedure, so that on every stream those interested may know how much of the water supply is controlled and how much remains to be acquired by others. It would seem that a statute to provide for this could be enacted, which would be at least as effective as the slow evolution of a doctrine by piecemeal through court decisions. The subject is of so much importance, and there exists such wide difference of opinion among those interested regarding what can be done and what should be done, that some of the legislation of other irrigated lands whose laws are borrowed from England are given below.

LEGISLATION RESPECTING RIPARIAN RIGHTS IN ENGLISH COLONIES.

CANADA.

Before any irrigation legislation whatever was enacted the Canadian government sent a commissioner to the western part of the United States to make a study of our laws. Upon his return this commissioner presented a report, in which the first suggestion was:

> First. The total suppression of all riparian rights in water, so that the same, being vested in the Crown, may be distributed under well-considered government control for the benefit of the greatest possible number.

The Northwest irrigation act[1] was formed in accordance with the recommendations of this report. The sections of that act, as amended in 1898, referring to riparian rights are as follows:

> SEC. 4. The property in and the right to the use of all the water at any time in any river, stream, water course, lake, creek, ravine, canyon, lagoon, swamp, marsh, or other body of water shall, for the purposes of this act, be deemed to be vested in the Crown, unless and until and except only so far as some right therein, or to the use thereof, inconsistent with the right of the Crown, and which is not a public right or a right common to the public, is established; and, save in the exercise of any legal right existing at the time of such diversion or use, no person shall divert or use any water from any river, stream, water course, lake, creek, ravine, canyon, lagoon, swamp, marsh, or other body of water otherwise than under the provisions of this act.
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> SEC. 6. After the passing of this act no right to the permanent diversion or to the exclusive use of the water in any river, stream, water course, lake, creek, ravine, canyon, lagoon, swamp, marsh, or other body of water shall be acquired by any riparian owner or any other person, by length of use or otherwise than as it may be acquired or conferred under the provisions of this act, unless it is acquired by a grant made in pursuance of some agreement or undertaking existing at the time of the passing of this act.
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> SEC. 8. Any water, the property of which is vested in the Crown, may be acquired for domestic, irrigation, or other purposes upon application therefor as hereinafter provided; and all applications made in accordance with the provisions of this act shall have precedence, except application under section 7, according to the date of filing them with the commissioner.
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> 2. The purposes for which the right to water may be acquired are of three classes, namely: First, domestic purposes, which shall be taken to mean household and sanitary purposes and the watering of stock, and all purposes connected with the working of railways or factories by steam, but shall not include the sale or barter of water for such purposes; second, irrigation purposes; and third, other purposes.
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> SEC. 9. No application for any purpose shall be granted where the proposed use of the water would deprive any person owning land adjoining the river, stream, lake, or other source of supply of whatever water he requires for domestic purposes.

Speaking of the abolition of riparian rights, Mr. J. S. Dennis, the commissioner who visited the United States, says:[2]

> In the Northwest Territories the land, with the exception of that which has been granted as subsidies to railway companies or alienated through homestead or preemption grants, sales, etc., all belongs to the Crown, and title to any of the water in streams, lakes, springs, or other natural channels had only passed from the Crown in so far as the rights of riparian owners were concerned, so the conditions were particularly favorable for the inauguration of a law regarding the diversion and use of the water supply for irrigation.
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> The investigations into this subject had led to the conclusion that the foundation provision necessary in an act of this kind was that riparian rights should be abolished, and the Government given a free hand to apportion or distribute the water and control its use in such a way that the greatest good to the greatest number would result therefrom.
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> The abolition of riparian rights and vesting the absolute control of all water in one strong central authority are the important provisions in the act. In many of the States in the United States riparian rights have been abolished, and title to the water vested in the commonwealth; but there the vacant lands belong to the Federal Government, and it is impossible to so combine the land and water, owing to this divided authority, as to secure the most beneficial results therefrom.
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> The provisions of our act on the subject of riparian rights will doubtless have to undergo the test of litigation, but assuming that the decision of the courts will be in favor of the act, there is no doubt

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[1] 58-59 Vic., chap. 33. See also Bulletin 96, Irrigation Laws Northwest Territories Canada, Office of Experiment Stations, U. S. Department of Agriculture.

[2] General Report on Irrigation and Canadian Irrigation Surveys, 1894, pp. 26-27.

that the one central authority, being vested with ownership and control of both the land and the water, should make it possible to so administer the two as to secure the greatest possible benefit to the greatest number.

PROVINCE OF VICTORIA, AUSTRALIA.

Riparian rights were abrogated in Victoria by the "irrigation act of 1886." The interpretation of the common-law rights which had vested in riparian owners prior to that time is set forth in the following extracts from opinions rendered in 1888:

By the general law applicable to running streams every riparian proprietor has a right to what may be called the ordinary use of the water for his domestic purposes and for his cattle, and this without regard to the effect which such use may have in case of a deficiency upon proprietors lower down the stream. But further, he has a right to the use of it for any purpose, or what may be deemed the extraordinary use of it, provided he does not thereby interfere with the rights of the proprietors either above or below him. Subject to this condition he may dam up the stream for the purpose of a mill or divert the water for the purpose of irrigation. But he has no right to interrupt the regular flow of the stream if he thereby interferes with the lawful use of the water by any other proprietors and inflicts upon them a sensible injury. (Miner *v.* Gilmour, 12 Moore P. C.)

A riparian proprietor has the right to use all water which he requires for domestic use and to water his cattle, and is also entitled to take from the river for any other purpose any quantity of water which will still leave in the river a sufficiency of water to substantially enable other riparian owners lower down the stream to exercise similar rights. This riparian right is still preserved by the act No. 898 (irrigation act of 1886), as to persons who had such a right at the passing of the act. (John Madden, Crown solicitor, in answer to inquiry from secretary of mines and water supply.)

In 1899 the following act relating to riparian rights was passed:

A BILL to declare and amend the laws relating to riparian rights.

Whereas it is advisable to define what are the special rights in the waters of rivers, streams, water courses, lakes, lagoons, swamps, or marshes appertaining to the ownership of lands abutting thereon, and to amend the law relating to such rights: Be it therefore enacted by the Queen's Most Excellent Majesty, by and with the advice and consent of the legislative council and the legislative assembly of Victoria in this present Parliament assembled, and by the authority of the same as follows (that is to say):

(1) This act may be cited as the riparian rights act 1899, and shall be read and construed as one with the water act 1890 (hereinafter called the principal act).

(2) This act and the principal act, and any act amending the same, may be cited together as the water acts.

Sections three and one hundred and fifty-three of the water act of 1890 are hereby repealed.

Every owner of land alienated from the Crown before the fifteenth day of December, one thousand eight hundred and eighty-six, abutting on a river, stream, water course, lake, lagoon, swamp, or marsh, there being no reserve between such land and the bank, shall have a right to the use of the water in the river, stream, water course, lake, lagoon, swamp, or marsh for the ordinary and domestic use of himself and of his family and servants, and for the use of his cattle permanently depasturing on such lands.

Every such owner shall likewise have the right to take and divert water from such river, stream, water course, lake, lagoon, swamp, or marsh for other uses on his riparian lands, provided such uses have been bona fide habitually exercised by such owner for not less than twenty years prior to the passing of the irrigation act of 1886.

A right to the permanent diversion or to the exclusive use or to any other than the ordinary and domestic use and the use of cattle of the water in any river, stream, water course, lake, lagoon, swamp, or marsh attaching to the ownership of any riparian lands by length of use or otherwise than under the provisions of some act of Parliament shall attach only to the riparian allotment as originally sold by the Crown and not to any other lands of the same owner. It shall not attach to any lands separated from the riparian lands by an allotment boundary or by a public road, or to any land distant more than one mile from the bank (ripa) in respect of which the right accrues.

Any owner of land alienated from the Crown before the said fifteenth day of December, one thousand eight hundred and eighty-six, claiming to have the right to take and divert water from any river, stream, water course, lake, lagoon, swamp, or marsh, being in or flowing through or abutting upon such lands for use thereon other than the ordinary and domestic use of himself and his family and servants, and of his cattle permanently depasturing on such lands, on the ground of his having exercised such use for not less than twenty years prior to the passing of this act, shall register his claim to such right within twelve months from the passing of this act.

It shall be competent for the Crown or for any landowner or for anybody or person to challenge such claim and to have an issue tried at law to settle the same.

All claims not registered within twelve months shall absolutely lapse.

Sections will be required to define the form and mode of making the statement of claim of any right to take and divert water from any river, stream, water course, lake, lagoon, swamp, or marsh, for uses other than ordinary and domestic use and the use of cattle, and to define the authority to receive such claims and to register them or to refuse registration and to provide for an appeal and the trial of an issue in case of such refusal and the nonacquiescence of the claimant therein.

Except as hereinbefore expressly provided, the water at any time in any river, stream, water course, lake, lagoon, swamp, or marsh shall be, and the same is hereby, declared to be absolutely the property of the Crown and inalienable, and the right to the use of all such water shall in every case be deemed to be vested in the Crown.

Where any river, stream, water course, lake, lagoon, swamp, or marsh forms the boundary of an allotment of land alienated by the Crown, the bed and banks thereof shall be deemed to have remained in the Crown and not to have passed to the landowner.

Except as hereinbefore expressly provided, or except under the provisions of some act of Parliament, no person shall divert or appropriate any water from any river, stream, water course, lake, lagoon, swamp, or marsh except in the exercise of the general right of all persons to use water for domestic and ordinary use and for the use of cattle from any river, stream, water course, lake, lagoon, swamp, or marsh vested in the Crown and to which there is access by a public road or reserve.

After the passing of this act no right to the permanent diversion or to the exclusive use of the water in any river, stream, water course, lake, lagoon, swamp, or marsh, and no right to take and divert such water for use on any riparian land other than the ordinary and domestic use of the owner and of his family and servants and of his cattle permanently depasturing thereon shall be acquired by any riparian owner or any other person by length of use or otherwise than as the same may be acquired or conferred under the provisions of some act of Parliament. And no such right shall be deemed to have been acquired otherwise than as aforesaid since the passing of the irrigation act 1886, notwithstanding the repeal of the said act.

A provision to entitle the Crown, by the minister of water-supply or his officers, to interfere summarily to prevent the undue, excessive or illegal diversion of water from any river, stream, water course, lake, lagoon, swamp, or marsh, and to lay on the person or body diverting, whether private landowner, trust, or other body or person, the onus of appealing against such interference and not on the Crown the onus of applying for an injunction or other process to restrain it or him.

PROVINCE OF NEW SOUTH WALES, AUSTRALIA.

Water-rights act of 1896.

Whereas it is desirable in the public interest to declare the respective rights of the Crown and of riparian proprietors to the waters of rivers and lakes, and to make better provision for the conservation and supply of water and for regulating drainage: Be it therefore enacted by the Queen's Most Excellent Majesty, by and with the advice and consent of the legislative council and legislative assembly of New South Wales in Parliament assembled, and by the authority of the same, as follows:

Rights of Crown and of riparian proprietors.

1. (I) The right to the use and flow and to the control of the water in all rivers and lakes which flow through or past or are situated within the land of two or more occupiers, and of the water contained in or conserved by any works to which this act extends, shall, subject only to the restrictions

hereinafter mentioned, vest in the Crown. And in the exercise of that right the Crown, by its officers and servants, may enter any land and take such measures as may be thought fit or as may be prescribed for the conservation and supply of such water as aforesaid, and its more equal distribution and beneficial use and its protection from pollution, and for preventing the unauthorized obstruction of rivers. For the purposes of this subsection "occupier" includes the Crown.

(II) The said right shall be subject to the following restrictions:

(*a*) It shall not be exercised in contravention of any right conferred on and lawfully exercisable by any person, company, corporation, or board by or under the authority of any act dealing with mining, or of any public or private statute or of any license granted by the Crown.

(*b*) It shall be subject to the rights of the occupiers of land on the banks of rivers or lakes as hereinafter defined.

(*c*) It shall be subject to the rights of the holders of licenses under this act.

2. The occupier of land on the bank of a river or lake shall have the right to use the water then being in the river or lake for domestic purposes, and for watering cattle or other stock, or for gardens not exceeding five acres in extent used in connection with a dwelling house, and it shall not be necessary for the occupier to apply for or obtain a license for any work used solely in respect of that right.

10. The license, if granted, shall in every case except Class IV be granted for a period not exceeding ten years, and shall (subject to the provisions of this act, with regard to the renewal of licenses and subject to such limitations and condition as the minister may think fit to make) be renewed by the minister from time to time on the application of the person holding the license, on the payment of a fee calculated in the manner and according to the scale set forth in the schedule to this act: *Provided*, That no renewal shall be for a longer period than ten years.

13. A license shall be deemed to be held by and shall operate and inure for the benefit of the lawful occupier for the time being of the land whereon the work is constructed or is proposed to be constructed.

NEED OF ADEQUATE STATE CONTROL OF STREAMS.

Typical homes, gardens, and orange groves of southern California are reproduced in illustrations of this report. They show the beautiful landscapes which irrigation has created and is destined to create. With other illustrations they serve to show the skill and success with which water is used, and Mr. Schuyler's report gives some remarkable examples of efficiency in distribution and high duty. The men who are displaying such skill and industry deserve well of the State. They ought not to have to work in this manner and watch for the sheriff at the same time, or to be compelled to leave their work to seek the sheriff's aid. This they sometimes have to do in California. In reply to an inquiry as to how he obtained his share of a stream, one gentleman said he first got a court decree, and then shipped in two men from Arizona who were handy with a gun. As a rule, irrigators and ditch owners are law abiding. Their dependence on the law and respect for it as a relief from worse conditions is often pathetic in the light of what it fails to do. Sometimes, however, exasperated and indignant appropriators from below make raids on the headgates and dams above, and scenes of lawlessness, loss, and violence are the result. The possibility of this is such that many irrigation contracts stipulate that water will be furnished if its delivery is not prevented by "unlawful invasion or unwarranted interruption," which means that they will continue to divert the stream until some rival appropriator blows up their dam. This stipulation against probable violence has never been noticed in water contracts outside of California. In Colorado, Wyoming, Nebraska, and Idaho, there is no further need of resorting to force because an appeal can be made to the State by anyone who thinks his rights are being encroached upon. The water commissioner in these States takes the place of the gentlemen from Arizona or of the mob. The result is peace and good will among neighbors and order and economy in the use of water. California needs the water commissioner as much as either of these States. Once tried, his services will never be dispensed with.

California also needs a law which will stop all further claims to water where the entire supply is now appropriated. Every ditch which can not be filled, every pump which can not be operated, every acre of land prepared for irrigation which is in excess of what the stream will serve, means either a loss of the money invested or the robbing of an earlier user; sometimes it means both. So long as the right to make new appropriations is unrestricted, so long will old rights be insecure.

Already disputes over the surface flow have extended to underground waters. Men cut off from the supply by surface ditches build galleries to drain it off through the ground, and call it developing water. Sometimes it is developing water and sometimes it is stealing it. Men who can not get artesian supplies tap and lessen these supplies with pumps. Upland wells are drained by lowland wells. Pipe lines in one orchard are empty because those in another are full. On one section inspected orange trees were dying for lack of water, on an adjoining one new groves were being planted, and the processes of appropriation and disappropriation were going on almost side by side.

The advantages of public control which would restrict the construction of additional works until it had been demonstrated that there was water for their use and provide for a just division among the works already in existence seemed so obvious that I sought from those directly interested an explanation of why an attempt had not been made to secure it. The reply in every case was practically the same. All classes of water users and water claimants united in saying the State government did not offer any prospect of remedy and that they could not afford to take any chances but preferred to come to an agreement among themselves.

It is not believed that this fear is well founded. It would take remarkably corrupt officials to create evils equal to those now existing. The notion that we must have human nature reformed and all the State machinery perfected before anything is done toward the regulation of streams is certainly erroneous. That any sort of system will remedy all these evils, or entirely avert controversies, is not expected. No matter how efficient a code of laws may be devised, or how honest and efficient their administration, there is certain to be friction because of the conflicting views created by the unfortunate absence of definite control in the past.

When Wyoming was admitted to statehood the water-right situation did not differ greatly from that of California. The records were scattered in the various counties; the claims were as extravagant, indefinite, and valueless as those compiled in this investigation. The Wyoming irrigation law of 1890 created a special tribunal called the board of control, of which the State engineer was made ex officio president, and intrusted it with the settlement of existing rights and the disposal of all unappropriated water. The board began with a river where controversies were acute and where appropriators were at war with each other. The river had not for several years supplied the needs of irrigators; hence no extravagant or speculative rights could be recognized without depriving late appropriators of their already scanty supply. At the outset the board determined to base all rights to streams on two principles: Actual use was to be the basis of all rights and the water was to be attached to the land rather than to ditches or ditch owners. In doing this it placed itself squarely in opposition to the doctrine which was most strenuously advocated and which was that appropriators had a vested right to the volume claimed in their recorded notices of appropriation, whether or not this volume had been used. In order to maintain its position the board had not only to know how and where water was being used, but to be able to show to all those affected by its decisions the source and accuracy of its information. The problem was not simply to satisfy its members that its decisions were lawful and right, but to convince appropriators that its policy was both just and wise. This required first of all a careful examination of the physical conditions along the stream. Each ditch diverting water was surveyed and its capacity measured. The area of the land it irrigated was determined, the flow of the river was gaged from time to time during the season, and records kept of the ditches which diverted this water. When these field investigations were completed maps and tables were prepared which showed the location and size of ditches, the land irrigated, and the measured flow of the stream. Equipped with this information, the board was prepared to pass intelligently on the claims of appropriators. The preparation and submission of their proofs was made simple by the use of a blank form which was in part copied after the desert proofs used in the United States land offices, and which enabled appropriators to state definitely, but briefly, the date when the ditch was built and the successive dates when the area irrigated was extended. Many were able to prepare their proofs without any advice or assistance and without incurring any expense, as the surveys, maps, etc., were all paid for by the State. Later on, when the State law was better understood, it was rare that these proofs contained either inaccuracies or misstatements, but at the outset some of the proofs submitted were curiosities. As it was known that the amount of the appropriation would be fixed by the acreage of land which had been irrigated, some of the claimants with expansive ideas included in their descriptions lands which were many miles away from and hundreds of feet above their ditches. Without the preliminary survey some of these proofs might have been accepted, but with the official map before it the board rarely failed to notice the discrepancies between the sworn statements and the actual situation. It required tact, firmness, and patience to have these attempts to secure excessive amounts of water rectified and prevent a rebellion against a rigid adherence to facts which was in striking contrast to the slipshod methods that had hitherto prevailed. It was made manifest, however, that the board always stood ready to correct its maps or measurements if they were shown to be in error, but until this was shown no variation between them and the proofs would be permitted. A few test surveys were made, but fortunately the official maps proved to be correct. Of late years their accuracy is rarely questioned.

When the agreement between the proof and the survey was finally secured a table was made which gave the acreage irrigated by each appropriator and the amount of water required under an assumed duty of 1 cubic foot per second for each 70 acres of land described. The law provides that after these proofs of appropriation have been submitted and before any action has been taken thereon by the board all interested parties shall have an opportunity to inspect them and contest any statements or claims believed to be erroneous. There was a large attendance at the first inspection and a general disposition to oppose the board's ruling that the volume of an appropriation should be determined by the acres irrigated rather than by the volume claimed. But when the total volume required for the land already watered was compared with the total flow of the stream, and these with the table of recorded claims, there was a complete reversal of this attitude. There were in all 132 ditches along the river. If claims to water were to govern, the first appropriator would have a right to the entire supply after midsummer, and the first six or seven would have a right to the entire supply at any time. This would leave the lands under more than 120 of the later ditches without any legal right to water. It was manifest, on the other hand, that if the board's ruling was maintained every ditch would have water during part of the season and with economy nearly all would have water throughout the entire season. The policy of the board was accepted, and the harmonious and satisfactory settlement of rights in the first adjudication has been followed by ten years of similar results. Beginning in opposition to preconceived ideas, the board has in the intervening years succeeded in defining and establishing over 4,000 territorial rights, with remarkably few contests or protests against its decisions. There lies before me as this is written the records of the last determination of territorial water rights made by the board of control. In all there are 236 appropriators, some of whose rights date back twenty years and amount in the aggregate to 500 cubic feet per second. All of the rights to a river and its tributaries have been determined in this one procedure, and this without friction between appropriators, and with a total expense to each of $1.75 in fees for the issuance and recording of each certificate of appropriation. This history of another western State has been referred to because it shows that rights can be settled without contest and without neighborhood ill feeling. The State has footed the bills, but it has been immensely benefited by its expenditure. It has promoted development, established peace where discord formerly prevailed, and added to both the selling and taxable value of irrigated land.

The settlement of water rights in Wyoming has been described not to suggest the adoption of the Wyoming law in California, but to encourage the enactment of some law by showing how order and security have been brought out of confusion not unlike that portrayed in this report. It has seemed more instructive to tell how a thing has been done than to theorize as to how it can be done. In some of its details the Wyoming law is imperfect. Later experience and a better understanding of the subject ought to result in more effective legislation. It is based, however, upon certain fundamental principles which are essential to the success of any irrigation system and hence seemed worthy of comment.

Another irrigation law worthy of the study of the people of California is the Northwest Irrigation Act of the Dominion of Canada. In its administrative methods it is the most complete and effective irrigation code yet enacted on this continent. A brief reference to this law is made in Bulletin No. 58, Office of Experiment Stations, but this has proven insufficient to a full understanding of its provisions, and a more complete discussion is presented in Bulletin No. 96.

THE NEED OF A SPECIAL TRIBUNAL TO SETTLE EXISTING RIGHTS.

The reports of Mr. Smythe and Mr. Grunsky show how little progress has been made in reaching a final settlement of existing rights in the courts. Professor Soulé filed with his report a statement of litigation on the San Joaquin which had, like the list of water filings, to be omitted because it was a volume in itself. The discussion of this subject by Judge Works[1] is to the same effect. All urge some plan for a simple, orderly, final settlement of all the rights along each stream. To show how little has been really accomplished by the court decrees thus far rendered, an abstract was made of the litigated cases named in Mr. Grunsky's report as follows:

ABSTRACT OF LITIGATION OVER RIGHTS TO KINGS RIVER.

Kings River and Fresno Canal and Irrigation Company.

August 10, 1875: Denied right to use Centerville channel of Kings River.

November 5, 1885: Ordered to remove dams, etc., from Kings River and Centerville channel thereof, and to cease diverting water.

Fresno Canal and Irrigation Company.

August 10, 1875: Granted right to use Centerville channel of Kings River.

March 6, 1892: Adjudged 100 cubic feet per second and no more, until Last Chance Canal is supplied with 190 cubic feet per second.

March 16, 1892: Adjudged 100 cubic feet per second and no more, until Lower Kings River Canal supplied with 189 cubic feet per second. Previous acts of diverting 500 cubic feet per second declared unlawful.

January 8, 1900: Adjudged 1,000 cubic feet per second as against the '76 Land and Water Company.

Centerville and Kingsburg Irrigation Ditch Company.

September 12, 1885: Ordered to remove all dams, etc., from Kings River and enjoined from diverting water or interfering with its flow.

February 25, 1900: Adjudged 600 cubic feet per second, subject to prior rights of three other parties, aggregating 673 cubic feet per second.

Arkansas Flat People.

February 25, 1900: Adjudged right to 19 cubic feet per second. (Probably subject to prior rights as noted above in case of Centerville and Kingsburg Irrigation Ditch Company.)

Fowler Switch Canal Company.

July 21, 1885: Enjoined forever from diverting any water from Kings River or from obstructing its flow.

Emigrant Ditch Company.

February 3, 1890: Adjudged 190 cubic feet per second as against Rancho Laguna de Tache.

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[1] Works on Irrigation.

76 Land and Water Company (Alta Irrigation District).

November 4, 1889: Enjoined forever from diverting water of Kings River, except for riparian lands on Kings River in Fresno County.

September 19, 1893: Its rights declared inferior to right of Peoples Water Ditch Company, to 200 cubic feet per second.

January 8, 1900: Adjudged 500 cubic feet per second, subject, excepting during October and November, to prior right of Fresno Canal to 1,000 cubic feet and water due from Fresno Canal to Peoples Water Ditch Company.

May 9, 1900: By stipulation its rights declared inferior to right of Last Chance Water Ditch Company to 217 cubic feet per second, excepting during September and October; also that, subject to this prior right of Last Chance Company, it is entitled to 750 cubic feet per second.

May 9, 1900: By stipulation its right declared inferior to right of Lower Kings River Water and Ditch Company to 182 cubic feet per second, but, subject to this prior right of Lower Kings River Company, it is entitled to 750 cubic feet per second. The area being actually irrigated from the '76 Canal is about 50,000 acres.

Peoples Ditch Company.

September 19, 1893: Adjudged 200 cubic feet per second as against 76 Land and Water Company.

July 23, 1895: By stipulation its right declared inferior to right of Lower Kings River Water Ditch Company to 25 to 100 cubic feet per second. (Record not clear as to amount.)

October 4, 1897: Adjudged 200 cubic feet per second, subject to prior right of other parties to 130 cubic feet per second.

May 15, 1899: Adjudged 450 cubic feet per second.

February 25, 1900: Adjudged 274 cubic feet per second as against claims of others amounting to 619 cubic feet per second.

Last Chance Water Ditch Company.

May 3, 1886: Enjoined from placing a dam on or obstructing flow of Cole Slough.

March 6, 1892: Adjudged 190 cubic feet per second, subject to prior right of Fresno Canal and Irrigation Company to 100 cubic feet per second.

April 13, 1897: Adjudged 250 cubic feet per second.

October 5, 1897: Adjudged, as against Peoples Water Ditch Company and Lower Kings River Water Ditch Company, water in Kings River in excess of 300 cubic feet per second, less a pro rata contribution to which Rancho Laguna de Tache is given prior right, until the excess equals 100 cubic feet per second.

February 25, 1900: Adjudged 217 cubic feet per second as against claims of others to 619 cubic feet per second.

May 9, 1900: Adjudged 217 cubic feet per second.

Lower Kings River Water Ditch Company.

April 17, 1885: Adjudged 100 cubic feet per second as against Rancho Laguna de Tache.

March 16, 1892: Adjudged 159 cubic feet per second, subject to prior right of Fresno Canal and Irrigation Company to 100 cubic feet per second.

July 23, 1895: By stipulation adjudged 25 to 100 cubic feet per second (record not clear as to amount) as against Peoples Water Ditch Company.

October 4, 1897: Adjudged 100 cubic feet per second, subject to prior right of Rancho Laguna de Tache to 30 cubic feet per second, as against Peoples Water Ditch Company and Last Chance Water Ditch Company.

February 25, 1900: Adjudged 182 cubic feet per second as against claims of others amounting to 619 cubic feet per second.

May 9, 1900: By stipulation adjudged 182 cubic feet per second as against 76 Land and Water Company.

Crescent Canal Company.

June 4, 1898: By stipulation adjudged 213 cubic feet per second as against Stimson Canal Company.

Stimson Canal Company.

June 4, 1898: Permitted to build dam or levee at or near North Fork and to take water so long as prior right of Crescent Canal Company to 213 cubic feet per second not interfered with.

Rancho Laguna de Tache.

April 17, 1885: Denied more than 30 cubic feet per second until Lower Kings River Ditch Company supplied with 100 cubic feet per second.

July 21, 1885: Given a decision perpetually enjoining Fowler Switch Canal Company from diverting any water from Kings River.

September 12, 1885: Given a similar decision against the Centerville and Kingsburg Canal Company.

November 5, 1885: Given a similar decision against the Fresno and Kings River Canal Company.

May 3, 1886: Given a decision enjoining Last Chance Water Ditch Company from enlarging lower channel of Kings River or from obstructing the flow in Cole Slough.

November 4, 1889: Given a similar decision against the 76 Canal and Irrigation Company, except as to riparian lands watered by it in Fresno County.

October 4, 1897: Adjudged 30 cubic feet per second as against Lower Kings River Ditch Company and Peoples Water Ditch Company.

This abstract and the discussion in his report shows that while the Fowler Switch Canal has been enjoined from diverting water it does divert enough to irrigate 10,000 acres, almost enough, one would suppose, to constitute a violation of the injunction. It shows that one right now serves land 30 miles above the place where the right was acquired, it having been floated that distance upstream. It shows that if there were no rights to the stream except the adjudicated ones, and the map which accompanies Mr. Grunsky's report shows there are, an attempt to divide the river in accordance with these would be an exceedingly difficult if not impossible performance. Whoever attempts it would have to determine how much of the stream belongs to the riparian proprietors. He would have to determine which of these adjudicated rights were entitled to water and which should go without. No matter how honest he might be, he could not expect to succeed because he would have no adequate guide for his action. The Fresno Canal and Irrigation Company has a prior right as against the Last Chance Canal of 100 cubic feet per second, and a prior right against the Lower Kings River Canal to a similar amount. It has a prior right to 1,000 cubic feet per second as against the 76 Land and Water Company, but what are its rights as against the other canals? No one has the least idea. The Centerville and Kingsburg Ditch Company has a right to 600 cubic feet per second subject to prior rights of 673 cubic feet per second. What are its rights outside of these 673 feet? It will take several more lawsuits to decide. The rights of the 76 Land and Water Company are inferior to those of the Peoples Water Ditch Company, the Last Chance Water Ditch Company, and the Rancho Laguna de Tache, but what is the rank of priority as against others? Only the courts can answer. The records show that the owners of the Rancho Laguna de Tache have had injunctions issued against the use of water by the owners of the Fowler Switch Canal, Centerville and Kingsburg Canal, and the Kings River and Fresno Canal. These injunctions have apparently not been dissolved, yet, in a subsequent action the court has permitted one of these canals to take water and it is being taken.

It is hardly necessary to follow the perplexity of this supposed officer any further. No ordinary mind would be equal to the strain.

The showing made by these official records is referred to in order to make clear that the State has a duty toward these creators of wealth which it is not discharging so long as it leaves any of them in doubt as to what is their just share of the river's flow, and puts upon them the entire expense of securing that share. Appropriators of water ought not to be subjected to the expense of protecting their rights. That is a duty of the Government and should be paid for by public taxation. It is the only way in which impartial justice can be assured. Leaving the ownership of streams to be fought over in the courts and titles to water to be established in ordinary suits at law has never resulted in the creation of satisfactory conditions and never will. As it now is the same issues are tried over and over again. Each decision, instead of being a step toward final settlement, too often creates new issues which in turn have to be litigated. The suit of one canal company against another company may settle the rights of these parties as against each other, but it settles nothing with respect to other appropriators not made parties to the litigation, and the whole controversy may be opened up at any moment. A stream with three appropriators has the foundation for at least three lawsuits: A *v.* B, A *v.* C, and B *v.* C. If there are four appropriators the way is open for six adjudications. Often the appropriators of a stream are numbered by scores and even hundreds. It might be interesting to compute the number of legal conflicts necessary to a judicial determination of the relative rights on streams like the Yuba, and these will, under the present procedure, increase with years because there will be new appropriations and old ones will be extended. It is not surprising that the petition for this investigation should state that the litigation is appalling. It could not be otherwise. Litigation is as natural a product of the absence of public control as are weeds in a neglected field.

There can be no stability under the present situation. The law affords no means of enforcing a right when once adjudicated except through another lawsuit. Irrigators can not live in peace. Litigation and controversy are forced upon them. To acquiesce in a new diversion, through sympathy, or for the sake of peace, may lay the foundation for an adverse right by prescription and end in the curtailment or the overthrow of all the rights of the peace lover. This uncertainty and the fear of being supplanted which grows out of it is the cause of much of the hostility with which appropriators regard new ditches, and is the motive behind much of the extravagance and waste which sometimes prevail in the use of water. With a right clearly defined and protected, its owner has no fear of shortage in time of need, and he is willing, when his crops do not require water, to have it utilized by others. But when the right is insecure or not defined the instinct of self-protection makes an Ishmaelite of every water user. His hand must be against every man, as every man's hand is against him. Duty to himself and to those dependent on him makes it necessary that he shall use all means at his command to discourage the establishment of rights which may later interfere with his necessary use of water. Under such a system every new appropriator is a new element of uncertainty and another menace to the peace of the community. The whole system is wrong. It is wrong in principle as well as faulty in procedure. It assumes that the establishment of titles to the snows on the mountains and the rains falling on the public land and the waters collected in the lakes and rivers, on the use of which the development of the State must in a great measure depend, is a private matter. It ignores public interests in a resource upon which the enduring prosperity of communities must rest. It is like A suing B for control of property which belongs to C. Many able attorneys hold that these decreed rights will in time be held invalid, because when they were established the public, the real owner of the water, never had its day in court.

ATTORNEYS AND COURTS NOT RESPONSIBLE.

The responsibility for this situation rests first of all with the irrigators and ditch owners. It arises from their reluctance to submit to any sort of supervision and effective control. Although attorneys and judges have had much to do with these controversies over water rights, they are in no sense responsible for their creation. In fact, under the present situation the courts are the only protection against a rule of force or anarchy. At present no class of citizens are doing more to reform the irrigation laws of California than its attorneys. Wherever they have been appealed to they have given their time and influence to promote the success of this investigation. One of the ablest arguments to which I have listened in favor of a special tribunal to make a final determination of all existing rights was made by a judge who, through painful experience, had become impressed with the danger of leaving these matters to be settled by accidental litigation, which always includes the judges among its chief victims.

Under a rational irrigation code titles to water are established like titles to public land, by proceedings which are wholly ministerial. This is the case under the Northwest irrigation act of Canada, and under the Wyoming irrigation law, where the supreme court recently held that even in determining territorial rights the State board of control acts as an administrative and not as a judicial body. (Farm Investment Co. *v.* Carpenter, 61 Pac. Rep., 258.)

If the amount of an appropriation depends upon the volume of water beneficially used, the first step in the determination of a water right should be a physical investigation. The water supply should be measured, the capacity of the ditch which diverts it should be determined, and the area and location of the land on which the water has been used defined. With these facts before it, the tribunal which fixes the amount of a water right has only a problem in mathematics. The judicial element is no more present than it is in fixing the taxable value of a horse or cow, in passing upon an assessment schedule, or determining whether or not a homesteader has complied with the land law. Determining the amount of water used is no more a judicial act than the fixing of a tax rate by a board of supervisors, the leasing value of land by a board of land commissioners, or hundreds of other acts of official and everyday life which require the exercise of ordinary judgment and discretion. One of the most mistaken and injurious beliefs is that rights to water can be settled only through a lawsuit. Nevertheless, the opinion seems to prevail widely, not alone in California but throughout the arid region, that water is a kind of property which must be disposed of exclusively by the courts.

THE NATURE OF RIGHTS TO WATER.

The water problem of California involves one of the serious social and economic questions of our time. Every arid State will watch the action taken and be influenced by it. The irrigated countries of the Old World will measure our ability to deal honestly and wisely with arid-land problems by the way this one is settled. The action to be taken, and some action should be taken, ought not to be shaped by laws borrowed from a country of rains and fogs or made to perpetuate the mistakes of the earlier lawmakers. It ought to represent the enlightenment of the twentieth century and the spirit of a republic instead of a monarchy. If it does it must have as a fundamental idea the giving of equal rights to all in our common heritage. The doctrine that air, water, and sunshine are gifts from God should not be lightly set aside even in arid lands. There is need for adequate protection for investments in canals and ditches, but this can be afforded without having the water they carry become private property or the stream itself become subject to private ownership. The growth and danger of monopolies in oil, copper, coal, and iron afford a warning of the greater danger of permitting monopolies in water. The growing belief in the public ownership of public utilities applies especially to water, that most essential of all utilities

In monarchies streams belong to the king, but in a republic they belong to the people, and ought forever to be kept as public property for the benefit of all who use them, and for them alone.

SHOULD APPROPRIATIONS BE MADE PERPETUAL OR LIMITED, LIKE FRANCHISES, TO A NUMBER OF YEARS?

The irrigation laws of all the arid States make rights to water perpetual. This was formerly the policy of many European countries, where it has since been abandoned, the practice now being to treat appropriations as franchises and limit their life to a definite period, usually fifty or ninety-nine years. It is worthy of consideration whether or not it will be well for California to make a similar change. Irrigation is as yet in its infancy, and our laws and policies are undergoing an evolution. A franchise to use water for fifty years would serve every purpose of development as well as a grant in perpetuity. It would be more effective if this franchise were adequately protected, while a grant limited in time would permit of any modifications which experience might prove advisable when these franchises expire.

The present tendency in cities toward the municipal ownership of public utilities will, it is believed, extend in time to the management and distribution of rivers. This is the tendency in all older irrigated countries where many of the works are operated as government property. Practically all of the ditches and canals in Italy are owned by the Government, as are all the more recent ones in India and Egypt.

What has been done in this country in the giving away of rights to rivers is only a reflection of the early policy of cities where perpetual franchises were not looked upon with any particular disfavor. The philosophy of this, as applied to streams, has been so well stated by Baird Smith, in his history of irrigation in Italy, that it is inserted:

> A grant in perpetuity of such a material as water, whose value must necessarily go on augmenting with the progress of agricultural irrigation, is an act of injustice toward the Government. * * *
>
> For there is no point better established by experience in northern Italy generally, and in Lom-

bardy particularly, than this, that the selfishness of grantees in perpetuity of water has been one of the most serious obstacles to the development of irrigation. Acting on the principle that they had a right to do what they liked with their own, they were in the habit of suspending arbitrarily the supplies of water disposed of by them to other parties under subordinate grants, of increasing as they thought fit the prices to be paid, and, in a word, of pushing to its utmost limits the right of absolute property purchased by them from the State. But an agriculture founded on artificial irrigation can not advance as it ought to do under such an arbitrary system. (Vol. 2, pp. 137 and 138.)

The holders of ancient grants in perpetuity have occasionally asserted an absolute right of property in the water thus granted to them, but the legal tribunals have invariably rejected such claims on the ground that the grants were made for the general good of the country as much as the special advantage of the grantee. (Vol. 2, p. 259.)

Because of this experience it has been found necessary, in order to secure the greater development and prosperity of irrigated agriculture, for the Italian Government to purchase a large number of these early and important grants in order that the State might reassume a comprehensive and effective control of the streams.

CONCLUDING SUGGESTIONS.

It is a significant fact that the gentlemen engaged in this investigation should have agreed in their recommendations regarding legislation. Being in accord with their views that the framing of irrigation laws is a State matter, and agreeing with the general features of the system recommended, no separate recommendations in this paper are required A few suggestions are offered regarding the practical operation of these recommendations should they become laws.

JURISDICTION OF SPECIAL TRIBUNAL.

Should a special tribunal be created to define existing rights, that tribunal should have exclusive original jurisdiction of this matter. It will not do to create such a tribunal and still leave the way open to litigate rights to water in the courts. Whoever is given control of this matter must have exclusive control. The party who files on a homestead must make his proof in the United States land office. He can not apply to the courts for a patent. If he could, demoralization in land matters would be prompt and certain. In the same way, if parties can elect whether they will go to the courts or go before a board of control, the board of control will be worse than useless. Suppose there are ten appropriators from a stream, if nine elect to have their rights settled before the board of control, and one goes into court, there will be two sets of priorities and unending complications as a result. A double jurisdiction can not be permitted in this matter any more than a railroad can be successfully operated with two presidents to direct its policy.

THE IMPORTANCE OF ADEQUATE PRELIMINARY SURVEYS AND INVESTIGATIONS.

If there is to be a special tribunal to determine rights to water, the justice and success of its labors will depend in a large measure on its action being preceded in every case by an adequate and impartial investigation of physical facts. Before it can determine how much water has been appropriated it must know how much water a stream carries. Before it can decide how much water has been beneficially used in irrigation, it must know the location and extent of the irrigated land, and have an approximate knowledge of the duty of water. Hence, streams must be gaged, the capacity and length of ditches must be measured, the area of land irrigated must be surveyed and its necessities determined. To make these measurements and prepare the necessary maps on a single stream is not a matter of days but of months, and it should be completed before the taking of testimony begins. Hence the creation of this tribunal and the inauguration of its work will not mean rapid change or sweeping revolution in existing conditions. The people of the State must prepare themselves to make haste slowly, and to continue to exercise patience and forbearance. If the first two years of this tribunal's existence witnesses the adjudication of rights on a half dozen streams it will have done well. Few of the people talked with realize how important an element time is in this matter. The creation of this tribunal is only a means to an end, not the end. The passage of a law creating it will only modify the existing situation. Rights on some streams will be defined the first year, on others the second, while it may be five or more years before some can be reached. Slow progress is inevitable, and while it is a reason for beginning promptly, it is not wholly a disadvantage. It will give timid appropriators an opportunity to realize that the labors of this tribunal do not mean the destruction of existing rights, but their protection. There will be some misgivings at first, and to allay these and avert opposition based thereon the tribunal should begin on a stream where the complications are few and the interests not important. If it acts wisely and conservatively it will succeed as have similar tribunals elsewhere. Later on its trouble will come with a demand for aid from more irrigators than it can assist.

THE FAVORING CONDITIONS FOR THESE ADJUDICATIONS.

In beginning its work in California such a tribunal will have many advantages over similar boards in other States. It can avail itself of their experience. It will have the aid and cooperation of the National Government to an extent not heretofore afforded the irrigation authorities of other arid States. The investigations of the Department of Agriculture to determine the duty of water have thrown much light on the necessities of irrigation, enabling rights to be established more nearly in accord with actual use than ever before.

THE PROTECTION OF RIGHTS TO WATER.

After rights are defined they must be protected. This can not be left to the appropriators themselves. Public control is a necessity. To make this control effective, so that each user will be assured of his just share, no matter how far from the mountains his farm is located, requires organization and administrative ability of high order. At the head of this system should be an irrigation engineer of demonstrated ability and executive capacity. When the tribunal has concluded its adjudication of the rights to a stream it should transmit a list of the priorities and amounts of appropriations to the State engineer, who should prepare proper instructions for his subordinates for the protection of these rights. The division of streams will require the State to be divided into districts of convenient size, the boundaries of which should be drainage lines and the number of the districts should be determined by the importance of the work to be done, the aim being to have no district larger than a commissioner can properly attend to. It will be impossible for the State engineer to discharge properly the other duties devolving upon him and give the necessary personal supervision to the work of these commissioners. This supervision will make it necessary for the State to be divided into larger areas, called divisions, and a superintendent should be provided for each. Southern California would form one division, northern California could be one at present, later on two will be required.

The State engineer should have charge of the surveys and measurements which precede the determination of existing rights. This will enable him to become familiar with the conditions on each stream, to have a knowledge of its water supply, and have in his office the records and information needed to promptly instruct water commissioners and superintendents in the performance of their duties.

THE ACQUIREMENT OF RIGHTS HEREAFTER.

Thus far we have considered only the rights already in existence. Provision should be made for the establishment of rights hereafter, so that development may proceed without any interruption or uncertainty. In order to do this all unappropriated water should be declared State property and the methods by which rights to this water may be acquired clearly defined. The State engineer should be given charge of this matter and it should be made necessary for every party desiring to appropriate water hereafter to apply to the State engineer for a permit. No one should be allowed to acquire a right without compliance with this provision. Taking State water without a permit should be dealt with in the same way as cutting timber from State land without a permit. It should be made a misdemeanor. A regulation of this kind is indispensable to securing an accurate record of rights to water or to protect existing rights.

The State engineer should have authority to refuse these permits where the water supply is exhausted or where the proposed use will be detrimental to public interests. In order that he may act intelligently on these applications every party applying for a permit should be required to give notice in some newspaper in the county where water is to be diverted of his intention to make such application, and this notice should show the location and amount of the proposed diversion. This will give parties likely to be injured an opportunity to communicate with the State engineer before he takes action. All permits issued should be made a matter of record in the engineer's office. The time of completing a right should be fixed in the permit, and when this time has expired the holders of the permits should be required to submit proof of their appropriations before the tribunal charged with the duty of determining them.

NAVIGATION RIGHTS ON THE SACRAMENTO AND SAN JOAQUIN RIVERS.

The largest volume of unused water in California comes from the Sacramento and San Joaquin valleys, and it is here that the greatest development in the future will take place. It is not believed that this increased use of water will seriously injure navigation interests, because a large percentage of the water diverted will return to the stream as waste or seepage. Irrigation will create a more uniform flow. There will be lower water in the spring and higher water during the rainless season. But, in order to avert any conflicts, the creation of a State engineering or irrigation bureau should be immediately followed by a conference with the officials of the United States Government having supervision over navigable streams, looking to such improvements of these rivers as will permit of the largest possible use of water in irrigation. The complete utilization of these two rivers will give California the largest rural population of any State in the Union. Whatever expenditure is necessary to protect navigation interests and enable this result to be brought about should be made. Even if it requires the construction of locks and the canalizing of both streams, the improvements will be well worth their cost, and, as it is a recognized field for the expenditure of Government appropriations, a proper presentation of the situation will, it is believed, lead to the extension of the required aid.

TERM OF OFFICE.

The value of any system must depend largely on the capacity of those who administer it. Incompetent men can make a failure of any law, while good men can do much with an imperfect one. The administration of an irrigation law in California will be a difficult matter under the most favorable conditions, and the broader the experience of those in charge the better will be the results. A water commissioner is not made in a day or a year. The longer a State engineer or member of the board of control serves the better equipped he will be to perform his duties. For these reasons the term of office of the members of the board of control, State engineer, and water commissioners should not be limited to two years. Six years is short enough term for the members of the board of control and State engineer, and not less than four years for the commissioners.

The reform of the irrigation laws of California involves the future of a great commonwealth. What is done should be done with the purpose of promoting the growth of the State and insuring the peace and prosperity of its citizens for generations to come. The possibilities which wait on success and the evils which will surely attend failure ought to enlist the efforts and intellects of the ablest and best men in the State. It is an opportunity for the exercise of constructive statesmanship which rarely appears in the life of any commonwealth. The task is not to piece together the discordant fragments of laws and decisions which now control, but to create an irrigation code worthy of an enlightened and self-governing people; to do for California what Napoleon and Cavour did for Italy, what Deakin has done in part for Australia, and Dennis more effectively for Canada. Success in this will mark the beginning of an economic revolution whose influence will be felt throughout the West. If the creation of institutions worthy of the time and place can come as a part of the world-wide movement of trade and population toward the Pacific coast, and of material development of arid America by public and private aid, which is now being so strenuously urged, the opening years of the twentieth century will witness a new era of home making in the West.

THE IRRIGATION PROBLEMS OF HONEY LAKE BASIN, CALIFORNIA.

By William E. Smythe,

Vice-President of the California Water and Forest Association.

INTRODUCTORY.

HISTORY AND RESOURCES.

The region on the eastern slope of the Sierra Nevada Mountains differs materially from all other parts of California. To the minds of its earliest pioneers these differences appeared to present an insuperable objection to the inclusion of Honey Lake Valley in the new State. They felt that the great mountain range had reared a natural boundary between the two slopes which men should respect, and in consequence sought by every means in their power to be left outside of California. The chief objection lay in the difficulty of communication between this remote region and the seat of government in the Sacramento Valley, especially in the winter season when legislation would be enacted.

Their first effort to free themselves from this embarrassment aimed at the formation of a new Territory, to which they gave the pleasant name of "Nataqua." Such a Territory was actually organized by a handful of settlers on April 26, 1856. The boundaries established included a large portion of Nevada, as well as a part of California. By a ludicrous blunder, arising from misunderstanding in regard to the exact location of the one hundred and twentieth meridian of west longitude, the founders of the new Territory were themselves excluded, while a much larger population in western Nevada which had not been consulted were within the boundaries of the impossible commonwealth. The code of laws adopted for the new political division disposed of the irrigation problem in the following brief paragraph:

> Sec. 8. No person shall divert water from its original channel to the injury of any prior occupant.

Probably this provision was intended to refer, not to the "prior occupant" of the water or the channel, as it reads, but to the occupant of the land along the stream, and was thus the first assertion of the riparian doctrine in this locality.

After the failure of this attempt to provide themselves with civil government, the settlers petitioned Congress to be included in Nevada. In the meantime they assembled in mass meeting and adopted (February 13, 1858) a new code purporting to be "The Laws of Honey Lake Valley." In this code the same provision for water appropriations was made as in the case of "Nataqua." The locality experienced various political vicissitudes, including an armed struggle (locally known as "the sagebrush war") between the Nevada people and those of Plumas County, Cal., before it was safely and finally incorporated as a part of the Golden State, in 1864. This was accomplished by the act of April 1 of that year, authorizing the formation of the new county of Lassen, which took its name from the valiant pioneer.

DESCRIPTION OF THE COUNTRY.

The Honey Lake Basin lies in northeastern California, between the Sierra Nevada Mountains and the State of Nevada. It is in the southern part of Lassen County, and separated only by the county of Modoc from Oregon. Its only railroad communication with other parts of California is by way of Reno, Nev., over the Nevada-California-Oregon Railway (narrow gage), the distance from Reno to the principal station in the valley being 80 miles. Although the extent of fertile soil and of potential water supply would be adequate to the support of a population, in country and in town, of at least 100,000 souls—and the character of surrounding resources and the demand for the natural products of the region would warrant it—the locality is but sparsely peopled, and even those who are there are forced to contend, through ceaseless litigation and neighborhood strife, for the comparatively small amount of water represented by the perennial flow of the streams. But the present population is decidedly prosperous, perhaps more so, on the whole, and considering the amount of capital invested, than the agriculturists in any other part of the State. For the most part they are engaged in raising hay and live stock, principally cattle and horses. Sheep and hogs are also very profitable. Natural hay is raised along moist river bottoms, and in a large district known as "The Tules," on the western border of Honey Lake. On the sagebrush lands reclaimed by irrigation three crops of alfalfa are raised each season, the total yield ranging from 3 to 8 tons per acre, with 5 tons as a fair average. On small areas, with skillful irrigation, this average should be increased considerably. Wherever small orchards have been established they have brought good returns upon the investment, though years when late frosts injure the fruit are not infrequent.

CLIMATE AND PRODUCTS.

The climate of the Honey Lake Basin differentiates it in a marked degree from California as a whole, and resembles the famous climate of New Mexico much more than that of southern California, the great interior valleys, and the coast region. The altitude of Honey Lake is 3,949 feet, and that of the surrounding watershed from 4,500 to 8,000 feet. This elevation, taken in connection with the intercepting barrier of the great mountain range, which cools the atmosphere and condenses the moisture into snow, makes the climate distinctly that of the temperate zone rather than that of the semitropics, which is so closely associated with the name of California. But the climate is extremely healthful, and to many people even more agreeable than that of the lowland or coastal regions.

The true designation of this locality would be the California highlands. Here the winters are not very cold nor the summers very warm. The climate is rather a mild type of the temperate zone. Frequently plowing can be done during every month of the year, but usually farming operations are suspended for about two months, from the middle of December to the middle of February. While exact data is lacking in regard to all the resources of the region, it is distinctly in the land of sunshine, and there are probably not far from 300 clear days in the average year. Ice forms on still water during a brief period in the winter, as a rule, for the thermometer frequently goes far below freezing at night—rarely below zero—though it is generally above the freezing point in the daytime, and the winter mean is considerably above it. The snowfall is mostly confined to the surrounding mountains, where it accumulates to a great depth. That which falls in the valley is slight, and shades off to nothing in the neighborhood of the lake. The spring season is windy and showery, and sometimes brings a belated snowstorm. The summer temperature occasionally rises to 100° or a little more, but brings little discomfort, because of the dry air and the invariably cool nights. The autumn is long and delightful, sometimes extending well into December. As a whole, the climate must be regarded as very favorable to the development of the highest forms of civilization. While it will not permit the production of the delicate fruits raised in other parts of the State, the hardy fruits and vegetables gain here a perfection of flavor and color which should give them a very large market when they can be shipped upon a sufficient scale.

SURROUNDING RESOURCES.

The natural resources surrounding Honey Lake Valley are both varied and valuable. One of the most important of these is the wide expanse of public grazing lands, bearing reliable crops of nutritious grasses and equal to the sustenance of vast numbers of live stock. The climate is also favorable to the live-stock industry and furnishes remarkable immunity from disease. The droughts which have sometimes afflicted other parts of the State have seldom if ever done serious injury in this locality. Live stock have sometimes suffered severely in hard winters, but this has occurred only rarely. Next to the grazing lands the large pine forests in the mountains and plateaus west of the valley constitute the most valuable item of surrounding resources. These forests are principally yellow pine, but also include quite a percentage of the more valuable sugar pine. This timber supply has thus far been drawn upon only in the slightest degree, but must be a great source of wealth in the future. Mineral resources are extensive and varied, but mostly undeveloped. There are mines of both precious and base metals and the country has not been prospected nearly as thoroughly as other localities. The two great needs of the region are an intelligent development of the water supply for irrigation, and then a new railroad outlet to connect with navigation on the Sacramento River and ultimately with the northern transcontinental railway lines and the Columbia River. With the development of irrigation and the consequent coming of population, the railroad would naturally follow, and the timber and mineral resources be brought into use. The mountain streams furnish considerable water power which might be made available at convenient points without decreasing the supply for irrigation.

A VARIETY OF PROBLEMS.

Taken as a whole, the Honey Lake Basin and its surroundings perhaps furnish as good an example of the irrigation and kindred problems as any locality that may be found between the Missouri River and the Pacific Ocean. Every phase of the water question in arid lands is here exhibited, with the single exception of interstate streams. Even this is escaped but narrowly by the chance which located the western boundary of Nevada a few miles further east than many people thought it ought to have been placed. This question may even yet arise in the future from the necessity of irrigating the eastern portion of the Honey Lake Desert with waters originating in California. But even now we see closely related to the economic life of the present and future population of this valley the problems of forest preservation; of management of the public grazing lands; of storage of vast quantities of water now worse than wasted; of the disposal of arable public lands to settlers; of rights, and limitations of rights, belonging to riparian proprietors; of litigation alike endless, wasteful, and demoralizing; of the duty of water for different soils and crops; of the means, financial and engineering, whereby the larger undertakings of the future essential to the highest good may be carried out, to the end that nature's precious gift of the waters shall reclaim the utmost acre, sustain the utmost family, and create the utmost home. Above all, there is the problem of providing a system of just administration which shall secure to all their fair proportion of that element without which their lands are worthless, but with which they are the source of certain income and enduring prosperity.

No locality illustrates more fully the evils inseparable from existing laws and customs in California and many other States than the Honey Lake Basin. So it happens that in this typical instance we may study the general problem of conquering the arid wilderness of the West and laying broad and deep the foundations of civilization.

THE WATER SUPPLY OF HONEY LAKE BASIN.

In considering the irrigation problem of this region we are confronted at the outset by the total absence of such exact information as should form the basis of anything approaching a scientific study of the subject. California has no State engineer and has not had for many years. During the existence of that office there was not time to examine the conditions of this remote section, since settlement and investment flowed to more famous parts of the State. Until the present inquiry was begun the National Government made no effort to study the resources and conditions of this locality. Under these circumstances the writer has no choice except to make use of such scattered and superficial information as may be had from the reports of private engineers, from his own observation, supplemented by interviews with the old settlers, and from such facts as his assistants in this inquiry have been able to gather in a short time during the past summer. Information of this kind is sure to be conflicting and conclusions based upon it certain to be disputed, but the effort will be to deal with the subject fairly and conservatively and to throw as much light as possible upon the complicated questions under these disadvantageous circumstances.

The most comprehensive report upon the whole subject of the water supply of this region which the writer has been able to obtain is that prepared by William Ham. Hall, civil engineer, in 1895. Mr. Hall served as State engineer of California for eight years, and until the office was abolished. Mr. Hall's visit to the Honey Lake region was a brief one, and it is only fair to state that it was undertaken for the purpose of reporting upon a private enterprise, rather than upon the broad public question which we are now considering. Moreover, he obtained his estimates of reservoir capacities and records of stream gaging from another engineer, as was necessary under the circumstances, and this other engineer was in the employ of the private enterprise, for the benefit of which the report was intended. Albert Halen, civil engineer, on whom he chiefly depended for such information as lay beyond the reach of his own hasty study, is a professional man of integrity and ability and of long experience in this locality.

HONEY LAKE SERVES TO MEASURE THE SUPPLY.

Mr. Hall based his estimates of the water supply of the basin upon a study of Honey Lake. In the absence of exact data, verified by stream gagings extending over a long period of years, there could be no better basis for a rough calculation. This is true because Honey Lake becomes the sink of all the waters flowing into the valley from any direction—Susan River and its tributaries from the west, Willow Creek from the northwest, Balls Canyon Creek from the north and northeast, and Long Valley Creek from the south and southeast. In like manner various smaller streams and large quantities of storm waters reach the sink. Thus practically all the water available for the irrigation of the valley lands, with the exception of that stored in Eagle Lake and other natural reservoirs at a considerable elevation above the valley, now reaches Honey Lake, and it is here that we can best form an estimate of its quantity.

Mr. Hall estimates the area of Honey Lake at its normal stage as 60,000 acres.[1] He says: "It has been known to carry its waters to a materially higher plane and consequent greater area and greater volume of loss per year; but it has also been known to recede to a very much lower level, much smaller area, and consequent less volume of loss per year." These variations are due, of course, to differences in precipitation; that is to say, in wet years, and especially after a series of wet years, the area of the lake is largely increased, while in dry years it is proportionately decreased. At rare intervals the lake has been known to go almost entirely dry, so that teams were driven across it. But 60,000 acres of water surface was taken by Mr. Hall as its normal area, and upon this he based his calculation of evaporative loss. It is clear, of course, that whatever amount of water the lake may lose by evaporation and still retain its normal area in years of average precipitation may safely be taken as the amount which, if properly saved and distributed, could be made available for irrigation. Mr. Hall says:

> It loses by evaporation the equivalent of 3½ feet in depth from this surface per year, so that as much water is carried into the atmosphere from it as would cover 210,000, say 200,000, acres of land 1 foot in depth, or as would amply serve in irrigation, allowing for loss in transit, over 100,000 acres each season. * * * The evaporative loss furnishes the key to the estimate, for it is not likely that there is any loss by seepage or percolation from it, except that necessary to keep the soils of its shores saturated, which is insignificant in amount when compared to loss by evaporation, as they do not support a heavy vegetation and are not of percolative character, being all of fine alluvium with a large portion of clayey matter.

Mr. Hall's estimate of loss by evaporation is conservative and rather below that which has been demonstrated elsewhere under similar conditions.[2] He is thoroughly familiar with world-wide data on this subject, and the figures he has given as the basis of available water supply may be accepted with confidence.

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[1] United States Government survey shows its area to be 64,000 acres, which is regarded as correct for its normal stage.

[2] Experiments of the California State engineering department over a period of five years show that the evaporation from Buena Vista, Kern, and Tulare lakes, which closely resemble Honey Lake in general character, ranges from 3.50 to 4.75 feet of depth per year. The evaporation from shallow fresh water lakes of Utah, as determined by United States irrigation survey, after five years' experiments, was from 3 to 4 feet per year.

To account for the water annually flowing into Honey Lake and lost by evaporation, Mr. Hall made a rough estimate of the water yield from various sources. To assist him in arriving at this estimate he had the help of local engineers and other observers, and the benefit of his own study of water courses and watersheds. But it is at best only an approximate figure in round numbers and chiefly valuable as indicating, in a general way, his view of the relative importance of the various sources of supply. The estimate is as follows:

	Acre-feet.
Susan River	100,000
Willow[1] and Pete creeks	30,000
Balls Canyon Creek	29,000
Long Valley Creek	34,000
All other sources	10,000

In dealing with the necessity of storage Mr. Hall calculates that of the three irrigations necessary—May, June, and August, respectively—the first might be taken wholly from the natural flow of the stream, while the second must be drawn mostly from storage, and the third entirely from that source. The chief value of Mr. Hall's report for our purpose is the fact that he furnishes us with scientific authority for the statement that 100,000 acres may be irrigated, in addition to the amount already in cultivation, from the waters which now flow uselessly into Honey Lake Valley and are there lost by evaporation. If we put the value of the product of an acre of land in this valley as low as $10 this waste of waters represents an annual loss to the community of $1,000,000. But this figure does not begin to measure the social and economic gain which could be realized by the proper conservation of the water supply. As the character of the streams is torrential, and the perennial flow far below the needs of agriculture when any great area shall be under cultivation, storage must be availed of upon an extensive scale.

CHARACTER OF WATERSHED.

The most painstaking estimate of the watershed tributary to Honey Lake Basin is that contained in Mr. Hall's report, and compiled by him, with the assistance of Albert Halen, civil engineer. This is as follows:

Watershed tributary to the Honey Lake Basin.

	Square miles.
Susan River, mountains to mouth of canyon	256.8
Mountain side south of Susan River Valley	25.6
Hills south of Susan River Valley	20.0
Hills north of Susan River Valley	36.2
Susan River Valley, to mouth of Willow Creek	47.4
	386.0
Willow Creek, above Pete Creek	101.0
Below Pete Creek	10.3
Pete Creek, exclusive of Horse Lake watershed	74.8
	186.1

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[1] Of the amount credited to Willow Creek, 5,000 to 7,500 acre-feet are due to the leakage from Eagle Lake, appearing at the head of the creek in the form of springs.

	Square miles.
Horse Lake and its drainage area	114.5
Balls Canyon, with Snowstorm and Secret Valley creeks	272.0
Long Valley Creek, exclusive of watershed of White Alkali Lake	230.0
Small streams and canyons, to basin direct:	
Hills north, Shaffer Peak to Hot Springs Peak and down ridge west of Skedaddle divide	64.2
Hills northwest of lake, Baxter Creek shed	19.0
Mountain side southwest of lake	53.6
	136.8
Total	1,210.9
Honey Lake and the basin lands	374.8
Grand total	1,585.7

The character of the watershed is by no means uniform. The Susan River watershed belongs to the first class in water-yielding efficiency, because it receives the largest and most regular snowfall, and is clothed in forests which insure the gradual melting of the winter's accumulation. The same is true of the mountains lying to the south of the valley, including the watershed of Thompson Creek. With the exception of the Pine Creek neighborhood, tributary to Eagle Lake, the vast remaining watershed is far from first class. It varies a good deal and there are seasons when, in consequence of unusually heavy snows, it sends enormous floods through creeks and canyons to the final sink in Honey Lake. But in ordinary years these barren hills possess small value from the standpoint of the water yield.

STORAGE SITES.

The problem of water storage to supplement the natural flow of streams presents in this region three remarkable features seldom found in conjunction. First, there are numerous good-sized reservoir sites where the engineer has but to assist nature by inclosing the outlet with dams and headgates, and reaching out low levees on either hand to effect their completion. The cost is so low as to make them entirely practicable and their size and location such that they may be utilized one at a time, and the system gradually extended to meet the growing needs of the country. Second, these natural reservoir sites are so distributed as practically to surround the valley and permit different parts of it to enjoy independent supplies. Third, there are three small lakes and one large one, which only require to be tapped to serve important uses. When these simple conditions are compared with those prevailing in many other parts of the arid region, where great storage works must be constructed before a single acre of land can be irrigated, they are seen to furnish extraordinary advantages to this locality.

The utilization of these striking opportunities for storage has begun, but the work is yet in its infancy. What has been attempted and what accomplished in the way of irrigation development, together with the difficulties encountered, will be sketched elsewhere in this report; but in this place it is proper to say that of the many reservoirs which have been projected from time to time on Susan River, in the mountains lying to the west of the valley, two have been partly constructed and are now in use, while two natural lakes, Caribou and Silver, have been tapped to more or less advantage. Preliminary work has been done at other sites. The most effective storage yet accomplished in the valley is represented by Lake Leavitt, which lies off the stream, with which it is connected by a canal, and is located in the immediate neighborhood of the land it supplies. North of the valley there are also opportunities for storage, notably on Balls Canyon, and here two small reservoirs are already in use. If the legal and financial conditions surrounding irrigation enterprise in this locality were as favorable as the physical environment, there would be a much longer record of accomplishment in the way of storage.

EAGLE LAKE.

Eagle Lake, one of the most beautiful sheets of water in California, lies at an altitude of 5,115 feet 25 miles northwest of Honey Lake Valley. It is flanked on one side by the forests of the Sierra and on the other by barren hillsides and low mountains. The area of this lake is nearly 28,000 acres and it is of great depth. As its elevation is more than 1,000 feet above the irrigable lands of Honey Lake Valley, it naturally suggests itself as a feasible supply for the reclamation of a great area. More than once enterprises have been organized for the purpose of tapping this great natural reservoir by means of a long tunnel through the lava dike which separates it from the head of Willow Creek Valley. When these enterprises have been in progress Eagle Lake has been advertised as a reliable water supply for at least 100,000 acres. On this subject there are two opinions and, as in any event this lake must sometime be an important factor in the reclamation of Honey Lake Valley to the largest extent, they may properly be mentioned here.

It is generally conceded that the level of the lake is practically stationary, except that it rises somewhat after a series of wet years and falls correspondingly after a series of dry years. This would seem clearly to indicate that, on the average, it receives no more water annually than it loses by evaporation and leakage. It is generally admitted that Willow Creek receives about 7,500 miner's inches by the leakage of water from the lake through the natural dike of lava. There are no other large leakages that are definitely known, but many people believe that numerous creeks and springs tributary to Honey Lake really owe their existence to the same source. The watershed of the lake is quite small and ridiculously disproportionate to the amount of service which is expected of the supply from this source. But in answer to this indisputable statement it is said by the strong believers in the project that the lake is fed by underground springs of enormous capacity. When they are asked to explain why, if such is the fact, the lake does not rise constantly higher and higher until it shall finally overflow, or at least largely increase the pressure upon the points of leakage, they answer only with the reiteration of their faith that Eagle Lake is practically inexhaustible and will furnish water for the whole country.

On the other hand, the skeptics regard Eagle Lake as a great delusion. They say it is a body of water with no visible outlet except the subterranean leakage into Willow Creek, and that if it were tapped by a tunnel 20 feet below its present level it would supply a large area for a few years, until drawn down to the level of the tunnel, and thereafter furnish only so much water regularly as might be saved from evaporation by decreasing the area of its surface. They calculate that this would be equal to the irrigation of about 5,000 acres of land. If no more than this could be irrigated the cost of the project would be prohibitory. They further say that the matter of watershed and under-ground springs does not enter into the question at all, since it is perfectly plain that no more water flows into this land-locked lake each year than escapes by evaporation and leakage; otherwise its level must rise steadily year after year until its water finds an outlet. They claim that there is but a single chance that the advocates of the project may be right, and that that chance lies in the possibility that by drawing down the level of the lake 20 feet very great leakages may be stopped, and the water so saved taken into the tunnel and thence to the lands in the valley below. The following simple illustration shows the skeptical point of view: Suppose you had a tank of a certain capacity and that the inflow of water at one side was exactly balanced by the outflow at the other, so that the level of the water in the tank remained always about the same. Suppose that you now put in a new pipe to tap the tank 1 foot below the surface of the water. Would not the new pipe necessarily draw down the water to its own level? If so, would the pipe thereafter draw any water at all? Certainly not, unless there were leaks in your tank between the mouth of the new pipe and the former water level.

Popular opinion in the locality is strongly on the side of those who believe Eagle Lake to be an inexhaustible supply, fed from mysterious sources, which will be equal to any demands that may be made upon it under any and all circumstances. Popular faith in it possesses almost the quality of a superstition. Scientific opinion, on the contrary, regards it as a delusion, though there are some local engineers who hold the popular view, justifying it on the ground that large leakages will be stopped when the lake is drawn down by the proposed tunnel, and that the water so saved, together with that which everybody admits would be saved from evaporation by decreasing the surface of the lake, would suffice for the irrigation of a very large area. It is a question which can never be satisfactorily settled until the experiment of the tunnel is actually made.

Wholly aside from the merits of this controversy, Eagle Lake is sure to be a factor in the future and to serve a purpose of the highest utility in connection with the largest reclamation of the valley below. Whatever else it is or is not, it is a great natural reservoir which might safely be drawn upon in dry years to save millions of dollars' worth of crops if the entire valley were in cultivation. It could safely be drawn upon for this purpose one year in ten, and probably three years in ten. This would be practicable provided the lake were made a part of a great system of irrigation depending for its regular supply upon streams and reservoirs elsewhere in the basin which are annually reenforced by the year's precipitation. In good years these other sources would furnish irrigation for the entire valley, but the history of the country shows that good years can not always be depended upon. There is always one dry year in every ten, generally two dry years, sometimes three. In such years the reserve available from Eagle Lake would save the entire valley and, charged as a capitalized cost against the whole, pay good dividends alike to the money invested and to the community.

RECENT WATER MEASUREMENTS.

Of exact data bearing on the question of water supply nothing is available except a few measurements made on Willow Creek and Susan River in the spring and summer of 1899 and the summer of 1900. These are as follows:

Stream gagings in Honey Lake Basin.

Stream.	Date.	Place.	Discharge.		Gager.
			Cu. ft. per sec.	*Miner's inches.*	
Willow Creek	Apr. 18, 1899	Mouth of creek	24.50	1,225	Albert Halen.
Do	do		24.50	1,225	W. D. Minckler.
Do	Apr. 23, 1899	Mouth of creek	27.68	1,384	Albert Halen.
Do	Apr. 24, 1899	Ravenscroft's	27.66	1,383	W. D. Minckler.
Do	June 4, 1899	Mouth of creek	25.40	1,270	Albert Halen.
Do	do	Ravenscroft's	24.39	1,219	W. D. Minckler.
Do	June 11, 1899	do	20.66	1,033	Albert Halen.
Do	do		20.66	1,033	W. D. Minckler.
Susan River	Apr. 18, 1899	Dam near mouth of Willow Creek	139.30	6,965	Albert Halen.
Do	Apr. 23, 1899	do	114.60	5,730	Do.
Do	June 4, 1899	do	37.20	1,860	Do.
Do	June 11, 1899	do	32.98	1,649	Do.
Do	do	Below dam	34.26	1,713	Do.
Do	Apr. 18, 1899	do	14.46	723	W. D. Minckler.
Do	Apr. 23, 1899	do	40.66	2,033	Do.
Do	June 11, 1899	Below Colony dam	34.27	1,713	Do.
Do		do	23.45	1,172	Do.
Susan River, North and South branches.	June 11, 1899	Above Colony dam	32.99	1,649	Do.
Susan River, South Branch	Apr. 24, 1899	Otis Johnson's	31.08	1,554	Do.
Do	June 4, 1899	do	30.28	1,514	Do.
Susan River, North Branch	Apr. 4, 1899	do	11.46	573	Do.
Do	June 4, 1899	do	6.92	346	Do.
Tanners Slough	Apr. 18, 1899		29.84	1,492	Do.
Do	Apr. 23, 1899		27.44	1,372	Do.
Do	June 4, 1899		14.65	732	Do.
Do	June 11, 1899		17.97	898	Do.

Having considered the physical resources of the country, with special attention to the water supply, we are now prepared to sketch what has been accomplished in the way of their utilization and to observe how existing laws and customs have influenced, for good or evil, the development of the irrigation industry in this typical valley of the arid region. This involves the consideration of the institutions of California in so far as they relate to irrigation, since the Honey Lake Basin is governed by the statutes of the State to which it belongs.

APPROPRIATION AND DISTRIBUTION OF WATER.

The great fabric of the California irrigation industry rests upon a slender foundation of organic law. This is supported by a considerable body of judicial decisions which have grown up during the past half century and which, though often vague and conflicting, have contributed much that is vital to this side of the economic life of the people. In subsequent pages we shall see the sources of these laws and of the decisions based upon them, and observe how great a contrast they present to laws which in other States and countries have furnished a secure foundation for water rights. But in this division of the report it is designed only to show what the laws are and to trace their influence through the history of one important valley to which they have been applied.

The statutes say that "the right to the use of running water flowing in a river or stream or down a canyon or ravine may be acquired by appropriation." This appropriation must be for some beneficial or useful purpose. The right ceases when the appropriator, or his successors in interest, ceases to apply the waters in this way. But the person entitled to the use may change the place of diversion, if others are not injured by such change, and may also change the place of use. Priority in time gives priority in right. Appropriations must be followed within sixty days by actual work; otherwise they lapse and the water which had been claimed may be appropriated by others. The rights of riparian proprietors are expressly exempted from the operations of this law of appropriation.

As the foundation of any system of administrative laws which may be adopted in the future is the method of establishing rights to the stream, it is well worth while to reproduce in full the brief regulations governing the actual process of appropriation. They are as follows:

> SEC. 1415. A person desiring to appropriate water must post a notice, in writing, in a conspicuous place at the point of intended diversion, stating therein:
>
> (1) That he claims the water there flowing to the extent of (giving the number) inches, measured under a 4-inch pressure.
>
> (2) The purpose for which he claims it and the place of intended use.
>
> (3) The means by which he intends to divert it, and the size of the flume, ditch, pipe, or aqueduct in which he intends to divert it.
>
> A copy of the notice must, within ten days after it is posted, be recorded in the office of the recorder of the county in which it is posted.
>
> SEC. 1421. The recorder of each county must keep a book, in which he must record the notices provided for in this title.

This is the entire law governing the method of appropriation and of recording the claims upon which property worth tens of millions of dollars, considering the State as a whole, is based. It will be observed that there is no provision for the exercise of public authority over these appropriations. It is also true that there is no public authority to which the intending appropriator may apply to ascertain whether there is any unused water in the stream to which he may properly lay claim. The case presents a striking contrast to the provision under which citizens may acquire or "appropriate" land from the public domain. All such lands have been properly surveyed and mapped. The public authority has made it easy to learn their location, extent, and general character. There is a central office at Washington, with numerous branches throughout the region in which the public domain is located, which keeps all these records, and no citizen need involve the risk of expenditure for improvements before knowing whether there is any land open to entry, or whether it has all been claimed and occupied.

Such legal protection for citizens is far more necessary in the case of public water than in the case of public land. This is so because a man may often see with his own eyes that certain lands have been claimed and improved in accordance with the law, while nothing short of a scientific study can demonstrate whether or not there is a surplus of water in the stream available for new appropriations. On this subject there is always a difference of opinion. The old resident is sure there is no surplus water, while the newcomer is equally certain that the present supply is being wasted and that he has a perfect right to claim his share and proceed to create his home. There can be no decision rendered between these conflicting opinions and interests until the matter has been brought to the test of actual experience. This is when the new ditch has been built, at great or little cost, as the case may be. When we come to consider the matter of lawsuits resulting from these conditions we shall see how even this costly test often results in decisions which do not decide, but merely involve all the interested parties in financial loss and vexation of spirit. The fact that this law provides no method by which the intending appropriator may know whether there is surplus water which he can legally claim, and, if so, the amount of it, is the first great evil we encounter in considering irrigation development, but is by no means the only failure in the law of appropriation.

The law says that the appropriator "must post a notice, in writing, in a conspicuous place at the point of intended diversion." Now, it may happen, frequently does happen, that "the conspicuous place" at which it is desired to divert the water is in some willow thicket at the lonely bend of the stream, where there are only jack rabbits and coyotes to see the notice so posted. Streams are not diverted in the main streets of populous villages, nor even on the main traveled roads of the country. The water is generally desired to be taken out at a point somewhat remote from the cultivated districts where men have their habitations. It must be taken at a sufficient elevation to enable the water to flow upon lands which, at the point to be cultivated, lie considerably above the stream. This stealthy method of appropriation is, then, open to the very serious objection that a projected enterprise which may be of great importance to the community can be initiated with all the privacy that a bank robber might desire for his operations. The further provision for placing the notices of appropriations in a book kept by the county recorder helps the matter very little. Such records are of course open to public scrutiny, but they are seldom scrutinized. The recorder himself has no function in the matter except to write the notices in his book. He has no means of knowing whether the new claim is justifiable and no authority to divulge the information if he possessed it. Neither he nor any other official representing the people has any means of knowing whether the projected work will be carried out, nor whether, in case it be carried out, it will be done in a way which accords with good public policy. Neither is there any method provided for ascertaining if projected works have actually been constructed. In a general way the public learns, after a time, that a man has built his ditch or has given it up, but their only means of knowing this is by their own observation or by hearsay.

The law says the appropriator must state the means by which he purposes to divert the water and the size of the proposed works. He must also apply it to a useful or beneficial purpose. The law goes no further. It provides no method by which the public may ascertain that he has taken only the amount of water to which he laid claim, or that he has applied it beneficially. All this is left to litigation.

The whole subject is treated as if it were a matter of no particular consequence and as if there were no more need of safeguarding the water supply than of governing the use of the air we breathe.

THE LAW OF APPROPRIATION AT WORK.

The first irrigation ditch in Honey Lake Valley was built in 1854. The notice of claim was as follows:[1]

> I, the undersigned, claim the privilege to take all the water out of Smith Creek (now Piute Creek) at the junction of the two forks where the stake stands. I shall build the dam some 6 feet high and carry the water along the South Hill to the emigrant road.
>
> ISAAC ROOP.
>
> August, A. D. 1854.
> Recorded this 1st day of May, 1856.

While it is thus apparent that water has been in use for irrigation in this valley since 1854, and while the county government was organized in 1864, a search of the records reveals the fact that the first claim filed and recorded in accordance with the law is dated April 27, 1872. It is the claim of D. C. Hall for 200 inches of Gold Run. There can be no doubt that during the interval of eighteen years between the filing made by Isaac Roop and the formation of the county government many appropriations were made, of which several were put into use. Doubtless the same was true of the period between 1864 and the first legal record which was filed in 1872.[2]

Taking the two periods together, there were twenty-six years—more than a quarter of a century—when the streams were being used without any legal record of appropriations. It is possible that the county records were destroyed by some of the numerous fires which have afflicted Susanville; but, as the record is intact for the last twenty-eight years, it seems more likely that lack of official data bearing on early appropriations is due to the looseness of the law and the slight significance which was attached to it by the public mind. Vested interests of considerable value must have been created by the use of the waters during the long period about which the official records are absolutely silent.

We have now reached the point where we may study with profit the record of appropriations on streams entering Honey Lake Basin and observe what light they throw upon the operation of the California irrigation law and the necessities of future development. For this purpose the voluminous record has been carefully searched and the entire data placed at the disposal of the author of this report, thanks to Prof. J. M. Wilson and his painstaking assistants. When these appropriations are viewed as a whole it is easy to see the risks involved in the irresponsible methods prescribed by the law and in the total absence of any system of administration for the protection of the public.

By far the most important stream entering the valley is Susan River, draining the rich watershed created by the eastern slope of the Sierra Nevada Mountains. As we have seen, it is estimated that about one-half of the entire drainage entering into

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[1] History of Plumas, Lassen, and Sierra Counties. San Francisco: Fariss & Smith, 1882.

[2] This is evidenced by some of the records of claims. One has the note: "Used the water for several years before posting notice." A more remarkable instance is a filing recorded May 10, 1898, which says: "Have used the water since 1862," thirty-six years before filing.

Honey Lake comes from this source. But, oddly enough, we shall discover that the total claims to water from the chief stream of the valley have been much smaller than those made upon several lesser streams. Indeed, there is one water course which contributes to Honey Lake only about one-third as much water as Susan River, yet over six times as much water has been claimed from the smaller as from the larger stream. It is thus apparent that the amount of actual supply has no logical relation to the extent of claims. How could it be otherwise in a State which makes no provision for the measurement of its waters and leaves its people to scramble blindly for the most precious of all natural elements in an arid land?

In the first place, there is no provision in the law for the cancellation of claims. They lapse if not applied with due diligence to a beneficial use, but there is no legal requirement calling for a record of such lapses. In the second place, as has been observed in foregoing comments on the law, there is no legal means of knowing that any appropriator has used the entire amount of water that he claimed. It is notorious that in California appropriators make no attempt to claim with even approximate accuracy the amount of water they need. The only rule is to be sure to make the claim large enough. This generally results in "claiming the earth," so to speak.

CLAIMS ON SUSAN RIVER.

The claims to waters of Susan River filed from April 27, 1872, to April 6, 1900, were as follows:

Filings on Susan River, 1872–1900.

Claims.	Claims.	Claims.	Claims.	Claims.	Claims.	Claims.	Claims.	Claims.
Miner's inches.	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*
200	2,000	600	250	75	500	20,000	200	500
300	300	500	500	400	100,000	100,000	10,000	10,000
2,000	300	200	10,000	1,400	500	10,000	1,000	10,000
400	2,000	300	40	2,000	144	200,000	1,000	5,000
500	600	250	300	1,500	300	10,000	500	500
150	40	50	500	2,000	600	10,000	50,000	10,000
2,000	500	100	500	300	100,000	40	100	200
300	1,000	300	300	100	5,000	20,000	10,000	
200	600	300	300	300	220,000	200	10,000	955,039
2,000								

The above total does not represent the entire claims on Susan River, however. The total number of claims was 92, while only 80 are included in the table. This discrepancy is due to the fact that 12 appropriations were couched in such indefinite terms that they could not be reduced to tabular form. As these indefinite appropriations reveal the utter laxness of California irrigation practice it is well worth while to reproduce some of the more striking ones:

W. B. Sargeant (1873) claimed "all surplus water (in the river) over and above the 2,000 inches claimed by A. A. Smith."

Z. N. Spalding (1873) claimed "the water taken out" of Piute Creek, a tributary of the Susan. There was nothing to indicate how much he had "taken out" or desired to take out.

J. H. Slater (1883) claimed "the waters in Caribou and Silver lakes and tributaries" without taking the trouble to estimate the quantity of these waters or to state the amount he needed and expected to apply to a beneficial use.

D. W. Ridenour and Charles Lawson (1887) claimed "all water here flowing in Gold Run Creek (tributary to the Susan) at any and all times of the year," notwithstanding the fact that there were 13 prior claims to the same stream, of which one had been made fourteen years before.

Elliott Winchester claimed "one-fourth interest in all the water flowing into the ditch (Batchelder & Adams), which carries about 3,000 inches."

D. C. Hyer (1893) appropriated "all the water here flowing and also the surplus water of Susan River at the point where this notice is posted," thereby bidding defiance to a multitude of prior appropriators and to the claims of posterity.

We have reproduced only a part of what may be termed the eccentricities of Susan River appropriations, but these will be enough to throw a strong light on the workings of the law.

CLAIMS TO WILLOW CREEK.

Willow Creek reaches Honey Lake Basin from the north and is a stream of much value to the community. It is estimated that its annual volume is about one-third that of Susan River, but we shall see that the amount of water flowing in the stream has nothing whatever to do with the quantity which the public will claim from it under the California system. Willow Creek has a very fair watershed, but it is generally believed that it draws its chief supply from leakage of Eagle Lake. The list of claims is as follows:

Filings on Willow Creek, 1872–1899.

Claims.	Claims.	Claims.	Claims.	Claims.	Claims.
Miner's inches.	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*
5,000	2,000	25	100,000	110,000	200,000
600	3,000	3,000	2,000	200,000	10,000
500	20	220	10,000	30,000	250
4,000	1,000	10,000	2,000	200,000	5,000
2,500	800	10,000	100,000	5,000	10,000
100	3,000	100	1,000,000	5,000	6,338,535
600	4,000,000	2,000	100,000	200,000	
800	20				

Those who searched the records of Willow Creek claims annotated the claims of 4,000,000 inches as follows: "Fortunately for Eagle Lake and Willow Creek, and for those residents of Honey Lake Valley who could not swim, this enterprise was never carried out."

The indefinite claims in this district include that of John Ruf and Adam Jakobs (1873), who modestly claimed "all water of Willow Creek." This did not prevent L. Knudson and others (1874) from also claiming "all waters of Willow Creek, being 2,000 inches, more or less."

BALLS CANYON CLAIMS.

The stream which flows through Balls Canyon is fed by Snowstorm and Secret Valley creeks, and during most of the year supplies comparatively little water. Its watershed consists mostly of barren hills and mountains which have no capacity to absorb or retain the moisture, but send it down in precipitate floods to the canyons below. The large appropriations made upon this stream were intended to be followed by the construction of storage works to impound these flood waters, but these undertakings have not been realized, except to a very limited extent.

Filings on Balls Canyon, 1877–1899.

Claims.	Claims.	Claims.	Claims.	Claims.	Claims.
Miner's inches.	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*
5,000	10,000	200,000	20,000	10	10
144	10,000	100,000	10,000	10	10
400	50	15,000	20,000	10	10
400	1,500	1,000	50,000	10	10
40	50,000	10	50,000	10	565,544
5,000	100	15,000	1,800	10	

There are several indefinite claims which can not be tabulated and a few conflicting ones which aim at the appropriation of all the water in the stream.

CLAIMS TO LONG VALLEY CREEK.

Long Valley Creek enters the Honey Lake Basin from the southeast, and is fed by numerous springs and small tributaries. Like all the streams of this region, it is torrential in character, and would yield a very large amount of water with proper storage facilities. There have been some ambitious attempts in this direction, of which at least one was far advanced when overtaken by a disastrous flood. The large claims which appear in the following table were made in connection with these storage projects.

Filings in Long Valley, 1872–1900.

Claims.	Claims.	Claims.	Claims.	Claims.	Claims.
Miner's inches.	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*
50	370	50,000	100,000	250	40
20	150	100,000	300	500	500
6,000	400	100,000	200	2,000	100
100	2,000,000	500	1,000	500	500
100	1,000,000	100,000	5,000	1,000	40
500	200,000	2,000	200	160	5,737,464
100	1,000,000	50,000	25	149	
1,000	2,000	320	75	10,000	
1,050	2,000,000	40	75	150	

There are a number of indefinite claims and several which claim every drop of water in the stream, but comparatively little water is actually utilized here at present.

Filings on Baxter Creek, 1872–1899

Claims.	Claims.
Miner's inches.	*Miner's inches.*
200	300
10,000	11,600
100	
1,000	

There were two indefinite appropriations, one claiming "all the water in the creek," and the other "one-quarter of all the water in the creek."

THE LAKE DISTRICT.

Under this head appropriations of small springs and streams having their sources a short distance from Honey Lake are classified.

Filings on streams and small springs near Honey Lake, 1872–1900.

Claims.	Claims.	Claims.	Claims.	Claims.
Miner's inches.	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*	*Miner's inches.*
50	40	200,000	30,000	10,000
2,000	50	20,000	10,000	200
100	100	250	100,000	160
100	100	100	50,000	821,350
50	5,000	50,000	1,000	
100	100,000	100,000	500	
200	50,000	20,000	200	
50	50,000	20,000	1,000	

There are many indefinite claims which can not be tabulated. For the most part they refer to springs and small streams, only suited to the individual supply of a single farm. An interesting feature in this district is the list of large claims on Skedaddle Creek. There are eleven of these, and not one of them was carried out to the point of effective use. There were also two large claims to water from Honey Lake itself, neither of which came to any result.

CLAIMS TO WATERS OF EAGLE LAKE.

The number of claims filed upon this great body of water is exceedingly modest, but the same remark does not apply to the amount claimed. The favorite project in this connection is that of tapping the lake by a tunnel about 1 mile in length, although there have been one or two attempts to solve the problem by pumping. The list of claims, covering a period of twenty-three years (1874–1897), is as follows:

Filings on Eagle Lake, 1874–1897.

Claims.	Claims.
Miner's inches.	*Miner's inches.*
3,000,000	400
3,000,000	1,000
4,000,000	100,000
4,000,000	14,201,400
100,000	

RECAPITULATION AND REVIEW.

It is interesting to bring together the entire list of claims made upon all the waters entering into Honey Lake Basin from 1872, the date of the first record which appears on the books of the county, down to the spring of 1900. We shall then have completed our survey of the law of appropriation at work and be ready to consider its financial, social, and legal results.

Recapitulation of claims in Honey Lake Basin.

	Miner's inches.
Susan River district	955,039
Willow Creek district	6,338,535
Balls Canyon district	565,544
Long Valley district	5,737,464
Baxter Creek district	11,600
Honey Lake district	821,350
Eagle Lake district	14,201,400
Total	28,630,932

Here are total claims, under the rules prescribed by the California law, of the bewildering amount of 28,630,932 miner's inches. In southern California, where the rainfall is materially less than in Honey Lake Valley, the amount of water represented by 1 miner's inch of continuous flow, measured under a 4-inch pressure, is considered sufficient to irrigate 4 acres of alfalfa, or 6 acres of citrus trees, or from 8 to 15 acres of deciduous trees. Making a fair allowance for the difference in rainfall and climate and the consequently shorter season in Honey Lake Valley, we may take 1 inch to 8 acres as the reasonable duty of water for diversified crops in the latter locality. Upon this basis the amount of water claimed in Honey Lake Basin, in accordance with the California law, would irrigate an area of 229,047,456 acres, which is considerably more than double the irrigable land of our entire arid region, according to conservative estimates, and represents a larger area than that occupied by most nations in Europe. Of course, it is not pretended that those who made these excessive claims so far deceived themselves as to imagine that the vast quantity of water to which they laid legal claim existed in Honey Lake Basin, or that they were bent upon the impossible task of irrigating the entire United States from this point. But the fact remains that these claims were actually made, in accordance with the law prescribed by the statutes of the State, and this fact has a significance which should not be lost sight of when we come to consider what measures of reform and constructive legislation will best promote and protect the irrigation industry.

The luminous fact which appears strikingly on the face of these statistics is that nobody knew how much water was available for appropriation, how much they needed, or, in case of those who followed up their claims with actual diversion and use, how much they received. The foundation of any system of water rights is the appropriation. If the method employed in getting this is faulty, the inevitable result is public or private disaster, and it is likely to be both. It is clear from the foregoing figures that the experience of Honey Lake Valley shows that the California method of appropriation is utterly reckless and fraught with the gravest perils to industry and society. The evils to result from such methods might be expected to make themselves felt when the country is well settled, and it becomes necessary to enforce the utmost economy in the use of the water supply. But we shall see that with probably no more than 20,000 acres under cultivation by means of irrigation these evils have already been sharply manifested, and that the troubles created and fostered by a system of bad laws have found no adequate cure in the courts.

THE DUTY OF WATER.

Among the important subjects to be dealt with in this report, according to the suggestions of the irrigation expert in charge, was that of the duty of water. Under any intelligent and permanent system of irrigation it is as necessary to fix upon some unit of water required for an acre of land as it is necessary in finance or industry to have a unit of value or of measurement. Men can not conduct exchange without dollars and cents to serve as units of value. They can not engage in manufacture or trade and ignore long measure and avoirdupois. There must be some basis of values, of weights, and of measures before men can deal intelligently and justly with each other in their daily transactions. In like manner it is necessary to fix upon some unit of water which shall represent the reasonable duty of that element in agriculture. This duty may be reckoned in miner's inches or acre-feet, as may seem most feasible, but it must be fixed in some terms, then recognized, accepted, and enforced. Otherwise the whole right of appropriation rests on shifting sands.

The importance of the duty of water is recognized in most localities where irrigation is practiced. Honey Lake Valley is, however, a remarkable exception to this rule. Here there is no common agreement as to the amount of water required to irrigate an acre of land. If one were to interview all the irrigators in the valley he would probably receive a different estimate from each person. Their opinions would vary in accordance with the peculiarities of the soil, differences of crop, and even with the temperamental differences of individuals. Take, for example, two riparian proprietors living side by side. One of them will tell you that if you will guarantee to keep the stream in its original channel he will ask nothing more, preferring to depend entirely on natural seepage. His nearest neighbor will demand that the entire stream be diverted and spread over his farm, and will intimate that if anything less than this be done he will spend his last dollar in litigation. The same contrast in opinion is found when you talk with the occupants of bench lands away from the stream, where the riparian element is entirely absent. One man wants all the water he can get, while his neighbor with similar soil and crops maintains that he gets better results with only half as much irrigation. When men differ about other subjects they leave the decision with the statutes or the administration. But in the matter of water each man is a law unto himself and resents interference or advice as he would if the same were offered with regard to the training of his children.

Neither law nor custom has fixed the duty of water in Honey Lake Valley Testimony touching this subject is sometimes offered in the courts, but there is no basis upon which just and consistent decisions may be rendered. The contracts of local irrigation companies make no reference to miners' inches or acre-feet. They merely agree to furnish water "sufficient to irrigate" a given number of acres. They promise that these acres shall be supplied with an "annual irrigation." They do not state whether this means water for one crop of alfalfa or for three. These vague arrangements are not supplemented by measurement of the heads of water turned into consumers' ditches. Everything is left to the superintendent and ditch riders, who try to apportion fairly the water that may be in the canals and reservoirs. These superintendents do remarkably well under the circumstances. There can be no justice in water distribution under such a plan. Indeed, injustice is the only possible result. The man who makes loudest complaint receives most water, while the one who is most patient and considerate is the certain sufferer whenever the supply is short. The trouble is due to the absence of any common agreement upon the reasonable duty of water. In other parts of the arid region there is such common agreement, established by custom and enforced by law.

THE DISTRIBUTION OF WATER.

The California statutes make no provision for the distribution of water among rival ditches or different consumers from the same ditch. Aside from the brief paragraph on priority—"first in time, first in right"—there is nothing which bears even remotely upon the matter. Everything is left for the irrigators to settle among themselves. This results in confusion and in bitter quarrels among neighbors. This condition of affairs must grow constantly worse as more land is put into cultivation, ditches extended, and appropriations increased. Each man manages his own headgate. His object is to get all the water he possibly can. We have already seen that he has no means of obtaining exact information in regard to the status of appropriations or the duty of water. All he knows—all he can possibly know under the circumstances—is his own necessity. Even as to this he is liable to be led astray, since nothing has been done to give the people of this remote locality the benefit of lessons which modern science has so generously conferred on many other communities.

The sins of the law are visited on unoffending neighbors. Enterprise is balked, and investment brought to ruin. One neighbor shuts down the headgate of another and stands over it with a shotgun. Retaliation follows upon provocation, and the evil passions so aroused invent new provocation and devise new methods of retaliation. A reservoir is built in the mountains to store the flood waters that they may be turned later into the channel of the stream and then diverted upon the lands of those who made this prudent provision to supplement their share of the perennial flow. But when the water is turned down, old dams are raised to intercept the increased supply and the water thus lost to those who furnished it. Costly works of diversion, built without injunction and even with the apparent approval of the community, are attacked and rendered useless by men who act upon the advice of their attorneys. It has come to be practically recognized that there is no law but force, and that when this law has exhausted the resources of its physical demonstration by overt acts the final resort is to the courts. We shall see how inconclusive and unsatisfactory a method this furnishes of settling the endless disputes, and how, after costly lawsuits and hurtful agitation, the quarrel travels back in a circle until it comes again to the point of physical violence.

> "Because the good old rule
> Sufficeth them, the simple plan,
> That they should take who have the power
> And they should keep who can."

The fault lies not with the people, not even with the lawyers, though the latter inevitably fatten upon the misfortunes of the community. The fault lies with the irrigation laws of California, which are notable alike for what they contain and what they omit. If deliberately devised to plague the people, no system which man's evil genius could invent would effect the result more surely than that system which invites them to make such reckless claims as we have seen in the case of Honey Lake Valley, and then leaves them to fight it out to the bitter end.

LITIGATION.

The water laws of California were framed with only the slightest appreciation of the ultimate character and importance of the irrigation industry. The source of the present statutes was the English common law, and it goes without saying that this took no account of the peculiar conditions of an arid or semiarid country. In England the doctrine of riparian proprietorship does not interfere with the vast majority of people living away from the streams. The climate is humid and the annual precipitation usually abundant. The farmer has no use for water beyond domestic needs, except to get it off his land as quickly as possible, and to do this he has frequently to resort to drainage. Streams are valuable for navigation and for power, but for neither of these purposes is it often desirable to divert them from their natural channels. The same conditions exist in the Eastern States, which adopted the English common law as the foundation of their jurisprudence.

In many portions of California the natural conditions are almost entirely reversed, and in such places the limited rainfall is received almost entirely in the season when least needed for the production of crops. Streams are not valuable for navigation, as a rule, since the flow of water is largely concentrated in the flood season, after which it dwindles to a slender volume or exposes dry channels. To assert the riparian doctrine under these conditions, and to enforce it to its fullest extent, is to make a dangerous monopoly of the water supply and to condemn to perpetual sterility millions of fertile acres which might otherwise make homes for millions of prosperous people. Had the Napoleonic code, rather than the English common law, been adopted by the early law makers of California, very different results would be shown by the irrigation industry to-day.

The judicial decisions which have given irrigation laws and practice their present character were based more upon the needs of mining than of agriculture. Mining was the first great industry, and it gave to all the customs and institutions of California a speculative color which they might otherwise have escaped. The first struggle for water arose in connection with this industry, and the glitter of gold blinded the eyes of lawmakers and people to the superior claims of irrigation. Out of these conditions came, not unnaturally, the assertion of property rights in water apart from the land to which it is applied. The following excerpt from a decision by Chief Justice Murray, in Hoffman *v.* Stone (7 Cal., 46–48), states both the doctrine and its history concisely:

> The former decisions of this court in cases involving the right of parties to appropriate waters for mining and other purposes have been based upon the wants of the community and the peculiar condition of things in this State (for which there is no precedent) rather than any absolute rule of law governing such cases. The absence of legislation on this subject has devolved on the courts the

necessity of framing rules for the protection of this great interest, and in determining these questions we have conformed, as nearly as possible, to the analogies of the common law. The fact early manifested itself that the mines could not be successfully worked without a proprietorship in waters, and it was recognized and maintained. To protect those who by their energy, industry, and capital had constructed canals and races carrying water for miles into parts of the country which must have otherwise remained unfruitful and undeveloped, it was held that the first appropriator acquired a special property in the waters thus appropriated, and as a necessary consequence of such property might invoke all remedies for its enjoyment or defense.

At a later point in this report we shall see how this theory of private property in water, regardless of the manner and place of its use, differs from the theory of water control which obtains in other States and other countries, and how it also differs from the theory on which the most recent and sweeping decision of the United States Supreme Court on this subject is based; but in this place we are considering only the California practice as it now stands and the consequences of that practice as observed in one part of the State.

A few other decisions may well be quoted to show how consistently the view of Chief Justice Murray has been adhered to:

Right to water acquired by appropriation may be transferred like other property. (McDonald *v.* Bear River Co., 13 Cal., 220.)

If the original appropriation was for a sawmill, the water may be used for a gristmill subsequently erected. (McDonald *v.* Bear River Co., 13 Cal., 220.)

If the water was appropriated for a mining claim, which is worked out and abandoned, the owner may extend his ditch and use the same quantity of water at other points or for a different purpose. (Davis *v.* Gate, 32 Cal., 26.)

A person entitled to divert a given quantity of water from a stream may take it at any point on the stream, and may change the point of diversion at pleasure, if the rights of others be not affected injuriously. (Butte T. M. Co. *v.* Morgan, 19 Cal., 609.)

The right of private ownership in water is therefore clearly established. This right entitles the owner to change the point of diversion or the place or manner of use at will, so long as it injures no one else. He may also sell his water like any other commodity. The following decision furnishes important light upon the question of measurement of appropriations:

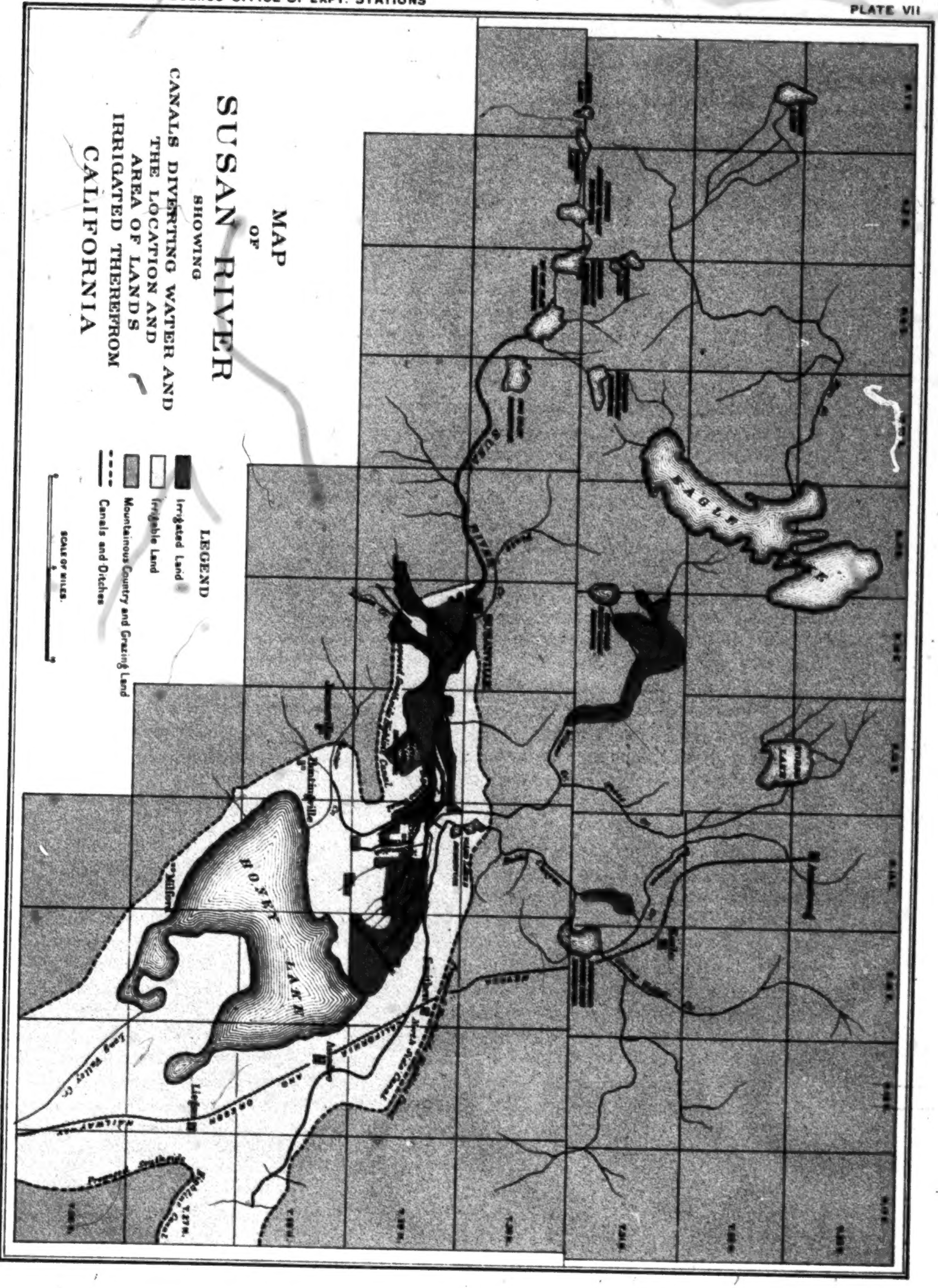
The prior appropriator is entitled to the water, so undiminished in quantity as to leave sufficient to fill his ditch as it existed at the time the locations were made above. (Bear River Co. *v.* New York Mining Co., 8 Cal., 327.)

It is necessary to understand the law and its accepted interpretation in order to comprehend the causes and results of water litigation in the basin which we are considering.

THE SUSAN RIVER COMMUNITIES.

While no stream entering the basin has been free from litigation, the struggle for the waters of Susan River (Pl. VII) has naturally been most prolific of lawsuits. In order to understand some of the chief elements entering into these troubles it is necessary to know the location of three different communities which have grown up with the aid of these waters.

While Susanville is the chief town and county seat, it is not an agricultural community, and its people have therefore been comparatively free from lawsuits of this kind. The first important agricultural community on the stream lies about 5 miles



MAP
OF
SUSAN RIVER
SHOWING
CANALS DIVERTING WATER AND
THE LOCATION AND
AREA OF LANDS
IRRIGATED THEREFROM
CALIFORNIA

LEGEND
■ Irrigated Land
□ Irrigable Land
▨ Mountainous Country and Grazing Land
- - - Canals and Ditches
SCALE OF MILES
EAGLE LAKE
HONEY LAKE
SUSAN RIVER

A. HOEN & CO. BALTIMORE.

east of the county seat. This is Johnstonville, more commonly known by the euphonious name of "Toadtown." Here a number of early settlers made their homes, planting fields and orchards, and becoming thoroughly prosperous through years of patient industry. Practically all are riparian proprietors, and much of their land is irrigated by natural overflow and seepage. Although the volume of the stream varies considerably from year to year, in accordance with the snowfall in the mountains, there is seldom any serious shortage at this point, except for late irrigation. Here is a group of farmers whose interests in the water supply are common and who therefore stand together when any controversy arises. Although each has his separate system of distributaries, they nevertheless work in cooperation in maintaining common dams and headgates and regulating the supply during the season.

Immediately adjacent to Johnstonville and extending 4 or 5 miles east is the neighborhood known as Buggytown.[1] This includes but a small group of settlers, whose chief canal is known as the Batchelder & Adams, taking water from the river at a point where it sometimes, though rarely, interferes to a slight extent with the Johnstonville farmers. The situation of the Buggytown people is such that they must divert most of their supply from the stream and lead it upon their lands through canals since they are able to irrigate only a portion of their lower lands from the natural overflow.

In the delta of Susan River, bordering the western and northwestern sides of Honey Lake, is the large Tule district, which has been rather conspicuously identified with the more important litigation in the valley. The dependence for irrigation in this locality is practically all upon the overflow, which is spread out upon the land by a system of crude dams and levees, and made useful in the production of wild hay. The total tonnage of this product is large, and therefore very important to the farmer of the neighborhood, but the yield per acre is slight compared with that of the alfalfa fields—probably not more than 1 ton of wild hay per acre upon the average. Through the elaborate network of sloughs and natural canals, in the midst of which the Tule homes and farms have been developed, considerably more than three-quarters of the vast quantity of water which goes to the making of Honey Lake finds its way to that sink in the heart of the basin. During the winter and spring large portions of the Tule district are under water and look like a part of the lake itself. Under these circumstances the farmers have no need of diverting and applying the water by the common irrigation methods. Nature has done the work for them—in a most slovenly and wasteful way, it is true—and they have but to throw up slight levees, with small dams in the depressions, in order to hold the water back until the soil is well saturated. In this manner they have had the benefit of all the flood waters which have made Honey Lake a body covering 64,000 acres of surface. It was inevitable that when, in the natural course of events, these flood waters should be needed for diversion upon the large areas of fertile sagebrush lands lying above the stream, the Tule district would be seriously affected. Either they must adapt their methods to changed conditions, applying the water supply more economically and scientifically, perhaps abandoning the wild-hay crop to a considerable extent and engaging in the production of alfalfa and diversified crops, or thousands and thousands of acres of fertile soil must remain forever useless and desolate. There was no other alternative. It was a hard situation for the Tule farmers; an equally hard one for the later settlers who were suffering for the water necessary to make their homes, and for those who had developed large private enterprises for the purpose of reclaiming the sagebrush lands. As the Tule farmers are riparian proprietors, with vested interests long established by actual use, they feel that any diversions which may diminish the quantity of flood water must be injurious to them. Out of these conditions costly litigation and much ill feeling among neighbors have come in the past.

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[1] One of the early settlers possessed a buggy at a time when such luxuries were somewhat rare; hence the name which has been accepted for the neighborhood.

The three communities sketched in the foregoing include practically all the old settlers of the valley taking water directly from Susan River. During the past ten years another community has been growing up on the higher sagebrush lands watered by Lake Leavitt and the system to which it belongs. This is somewhat widely scattered, but is united by a common interest in the waters that may be saved from waste by storing the floods and enforcing a more economical use of the perennial flow in periods of plenty. These new farmers produce three annual crops of alfalfa, with a yield ranging from 3 to 6 tons per acre, against 1 ton per acre of wild hay from the river bottom and tule fields. It is here that small, diversified farms and well-kept orchards may be expected to develop in the future, since these results are always associated with the more economical and skillful use of water. The rise of what was originally known as the Leavitt system, and is now the property of the Colonial Irrigation Company of Honey Lake Valley, has intensified the struggle for water and precipitated several lawsuits which seem to involve the development of the country to a marked degree. Old settlers have opposed this system only to the extent that they feared it might encroach upon their established rights and deprive them of water which they had formerly used and still used for the production of their crops. They concede that there are flood waters now wasted which might be stored to the advantage of the whole community, but under prevailing laws it is extremely difficult to carry on a system dependent upon the use of flood waters—partly by diversion and partly by storage—in the midst of riparian owners and old appropriators who have no conception of the actual water supply, of the duty of water, nor the methods of distribution employed in countries having more enlightened laws. Again, it should be said that the trouble lies not with the people themselves, but with the system which compels them to settle by physical force and wasteful litigation the controversies which should have been settled in the beginning by a proper method of appropriation, and the results of which should be enforced by a system of administration commanding everybody's respect.

CAUSE AND CHARACTER OF LAWSUITS.

It might be expected that in the early days of the country's settlement there would be water enough for all, and therefore no occasion for litigation. The first judgment, however, bears date of June 7, 1864, and related to the waters of Lassen Creek. The plaintiffs were awarded 75 miner's inches and the defendants enjoined against interfering therewith. The case has no special interest for the present inquiry except as marking the beginning of the water controversies of the valley. The total number of judgments in the period of thirty-six years, from 1864 to 1900, was fifty-three. Of these thirty-five related to Susan River, seven to Willow Creek, three to Balls Canyon, three to Long Valley, two to Baxter Creek, and four to the lake district. Every one of these suits may be traced to the laxness of the appropriation law and the absence of the exercise of public authority over the distribution of water. While the financial loss occasioned by this litigation, direct and indirect, may only be guessed at, it is perfectly safe to say that if the same amount of money had been used in storing flood waters it would have furnished a satisfactory supply to all parties engaged in the lawsuits and irrigated much more land than is now in cultivation. These suits were of three classes, as follows: First, those which arose from conflicts between appropriators as to the amount of water each was entitled to use; second, those which came from misunderstanding as to the precise meaning of judgments previously rendered; third, those which were due to the vague and indefinite terms of contracts between irrigation companies and consumers. In order to show more clearly the evils arising from present laws and the prevailing theories of water ownership and control, it is proposed to analyze three typical cases representing these different aspects of the matter.

"THE BIG WATER SUIT."

What is locally known as "the big water suit" began with the filing of complaints on July 12, 1890, and ended with stipulated judgments in January and February, 1893. Although there were thirty-four of these judgments, involving more than sixty litigants, they all related to the title to the waters of Susan River and its tributaries (including Willow Creek) as between the residents on these streams and the farmers of the Tule district on the shores of Honey Lake.

This suit marked the beginning of the inevitable struggle between those who desired to have the waste waters flow "as they had been wont to flow from time immemorial" and those who desired to store and divert these waters so that the arid lands might be reclaimed. In a word, it was the irrepressible conflict between natural irrigation and artificial irrigation. The adoption of the former method would limit the amount of land that may be cultivated in the future to that which can be sufficiently moistened by the spreading of the waters in times of flood and by the seepage from streams in times of perennial flow. It is true that by very crude devices and some slight labor water is held upon the fields a little longer than it would otherwise remain. Practically, however, natural irrigation means simply that man shall rest satisfied with what nature has done, and that agriculture shall be limited to the moist lands in river bottoms and around the margins of ponds and lakes. Artificial irrigation, on the other hand, aims as much to keep the water off the land when it is not needed as to bring it on the land when it is needed. The utility of artificial irrigation in a given locality is not limited at all to the area naturally flooded, but only by the actual amount of water which the stream may contain. Each miner's inch of this water is equal to the reclamation of a certain number of acres. It is the office of artificial irrigation to see that the maximum amount of land is irrigated with the minimum amount of water. The moment that artificial irrigation begins to assert itself trouble arises with those who depend on natural irrigation and claim the entire volume of the stream for those wasteful uses which have furnished sustenance to their crops of native hay and water grasses. In the end one system or the other must prevail. Either the water must be used for the greatest good of the greatest number or the country must be abandoned to a few amphibious farmers living in the midst of cattle and wild beasts. Those who claim the protection of the law in the continued enjoyment of natural irrigation are no more selfish than other men. They stand upon their rights as they understand them and are perfectly sincere when they contend that any interference with the natural flow of the stream results in loss and consequent injustice to them. They claim that all the water they have had in the past is actually needed to properly irrigate their land. It is perhaps true that the water is needed for the kind of irrigation they have practiced. But this in nowise alters the fact that the issue raised by these conditions involves the whole future of the country under consideration. The country in Honey Lake Basin will be sparsely or densely peopled, will produce little or vast wealth in aggregate, will linger upon the edge of semibarbarism or move forward to the enjoyment of a high state of civilization, according as this question is answered in one way or the other.

These issues were raised for the first time in "the big water suit." The time was favorable for the storage side of the question, since it fell in a period of wet years when the Tule district was really suffering from an excess rather than a dearth of water, even when judged from the standpoint of natural irrigation. The advocates of storage argued that the carrying out of their plans would do the Tule farmers more good than harm by reducing the winter and spring overflow, when the excess of water really amounted to a nuisance, and by keeping up the flow of the stream later in the irrigation season as the result of seepage from the higher lands. In behalf of the more economical and skillful use of water, it was urged that the Tule farmers would be still further benefited if they restricted the product of wild hay as much as possible and raised alfalfa upon their better lands. The difference between one lean crop of poor native grass and three good crops of alfalfa would add enormously to the wealth of the Tule district, it was argued. To illustrate, one Tule farmer has an estate of 3,000 acres. Half of this estate is in sagebrush and of no value except for inferior pasture. The other half is watered by the overflow and produces about 2,000 tons of wild hay worth, say, $8,000. With water properly stored and distributed his sagebrush lands would produce 4 tons per acre of alfalfa, or a total of 6,000 tons, worth $30,000. Capitalize this at 10 per cent (which money is worth in this locality) and it would increase the valuation of the estate at least fivefold. From this illustration, which represents average conditions in the Tule district, it clearly appears that the Tule farmers are themselves large sufferers in consequence of the vicious system of natural irrigation, though the entire community shares in the great loss, just as it would share in the benefits which might accrue from the more enlightened forms of irrigation practice.

Before considering the effects upon storage enterprises of "the big water suit," it will be interesting to examine some of the minor judgments in that case.

SOME BEWILDERING DECISIONS.

Indefiniteness is the characteristic of the large majority of decisions which have resulted from water litigation in Honey Lake Basin. Judgments are rarely expressed in quantitative terms, and when they are, the language more frequently refers to proportions of stream or ditch than to a specific number of miner's inches. We quote from some of the judgments in "the big water suit:"

> Defendent Robert Johnston, administrator of estate of Nicholas Lute, deceased, adjudged right to use waters of stream for irrigation of lands described in his answer, and for watering stock and domestic purposes to the extent that they have been heretofore used, as set out in his answer in said cause.
>
> Defendant Charles Lawson adjudged right to use of waters of Gold Run Creek in same terms as in Defendant Johnston's case. [Language identical.]
>
> Defendant D. W. Ridenour awarded waters of Gold Run in same terms as two preceding defendants.

Five defendants received judgments in identical terms, and it would seem that none of them was in a position to know definitely what rights he had won as the price of the lawsuit. The end of the case found them precisely where they were at the beginning.

> Defendant W. N. Cain adjudged sufficient water to irrigate about 18 acres of orchard land and for stock and domestic uses.

Even the amount of land is left indefinite by the use of the word "about," and no definite quantity of water is mentioned.

Eleven defendants in the Johnstonville neighborhood were disposed of as follows:

> * * * Adjudicating riparian rights to flow of all waters of stream in natural channels flowing across their said lands. Right to use of water on irrigable lands is shown on plat filed and marked "Exhibit A," by appropriation to amount necessary for production of crops. Each defendant shall return surplus water diverted to the stream, except such as may be conducted to adjacent irrigable lands to other defendants. [Two defendants excepted from requirement as to return of water.]

Here is a group of important farms the water rights for which, aside from those of riparian character, are expressed in the vague phrase, "amount necessary for production of crops." Who is to say what amount is necessary for the purpose? Supposing rival claimants assert that an unnecessary amount is being used, how is the matter to be settled? By more lawsuits, of course. There can be nothing final or satisfactory about such an adjudication in a growing country.

> Defendant L. Woodstock: Judgment for sufficient water for 200 acres [which is described] and for irrigating, stock, and all domestic use thereon.

The judgment goes on to describe the size of the flume in which the water is to be taken, thereby furnishing some hint as to the extent of the right; but even this is upset by the latter part of the judgment, which says the defendant may use "said ditch and flume when same does not interfere with rights of plaintiffs." Who is to say when the plaintiffs' rights are actually interfered with? If the plaintiffs, then there is no doubt that interference will begin at an early date; if the defendants, then we may predict that there will never be any interference. Nothing is settled by such a decision. It means another lawsuit as soon as dissatisfaction arises on either side.

> Defendants N. Holmes, Otto Ranker, and J. Van Notten: Judgment for 50 inches of water to be diverted by defendants into their ditch at all times when there is water flowing from Susan River into what is known as the Dill Slough and Little Slough, for irrigation, stock, and domestic purposes on their several premises and no other. In times when there is more water than plaintiffs need, defendants may divert and use additional water as they may require.

Here is another judgment of similar character, but even more bewildering:

> Defendant Charles Hartson: Has right to divert water of Big Slough for irrigation of [land described] and for domestic and stock purposes to extent of one-fourth of waters flowing in said slough

prior to May 10 of each year. From May 10 to June 20 said defendant shall have one-fourth of said water, provided that said one-fourth shall not exceed 50 inches. In times of extreme drought defendant's one-fourth shall not exceed 25 inches from June 20 to August 1. In addition defendant shall have all waters turned into said slough by plaintiffs prior to August 1. After August 1 defendant shall have one-quarter of said waters so turned into said slough. Plaintiffs have right to divert water for irrigation, stock, and domestic use, and have right to maintain dams and bulkheads and regulate flow of water down Van Notten, Dill, and Big sloughs, and to exclude all the waters of the river from said sloughs from and after May 10 of each year, and to compel waters to flow down main channel of Susan River from June 20 to August 1. Plaintiffs have right to use sloughs as waterways for diverson of water from their land. Defendant shall not in any way interfere with exercise of such rights by plaintiffs.

Would it be possible to frame a judgment in more indefinite terms? How could such a judgment settle anything? The interests of these neighbors, plaintiffs and defendants, are diametrically opposed. Each wants the stream to flow in a different direction, and the season's crop is staked upon the result. Under such circumstances there can not possibly be an agreement as to what constitutes "one-fourth" of the water. The actual result of this case was a fierce quarrel, on the merits of which the community was divided. When the defendant lifted his headgate, the plaintiffs shut it down. There was shaking of fists and brandishing of shotguns. Then came the lawsuit. The defendant won, but it was immediately announced that the plaintiff would bring another suit. Neither the quarreling neighbors nor the court which tried to adjust their grievances is to be blamed for the unhappy state of affairs. The fault is in the law on which the California irrigation industry is founded.

The judgments quoted are not exceptional, but representative of the entire list. If we took up each one separately we should find nearly all of them inconclusive and incapable of being carried out to the satisfaction of both parties, taking human nature as it is. They are decisions which do not decide—which not only invite more lawsuits, but practically compel them. In this connection it should be remembered that the law provides no method for the distribution of water under public authority. Each man is a law unto himself until somebody takes him into court, and he emerges from that tribunal no wiser than when he went in.

THE STIPULATION AS TO STORAGE.

We come now to the vexed question concerning the use of the surplus waters of Susan River as between the storage enterprise and the farmers of the Tule district. The stipulated judgment in this case, as condensed by those who searched the record for the purposes of this report, reads as follows:

Defendants B. H. Leavitt and C. C. Hutchison: Defendants to have right to store and use waters of Susan River from March 1 to July 1, providing 1,000 inches of water are permitted to flow in the channel of Susan River immediately above the mouth of Willow Creek. During the remainder of the year defendants may use and store all waters in excess of 250 inches flowing at point aforesaid. Provides methods of measuring water in case of dispute as to the amount flowing at mouth of Willow Creek. Fixes limit of evaporation and loss of waters stored in reservoirs at head of river, in passing from said reservoirs to Lake Leavitt, at 10 per cent.

It was believed by the defendants in this case that their success in obtaining this stipulation marked the beginning of a new era in the irrigation development of Honey Lake Valley. The Tule district had yielded its right, in the view of the plaintiffs, to the entire waters of Susan River, except 1,000 inches from March 1 to July 1 and 250 inches from July 1 to March 1. As the appropriations above Willow Creek are comparatively insignificant, and as nearly all the water taken to satisfy them is used in such a manner as quickly to find its way back into natural channels, the plaintiffs thought they were henceforth secure in the possession of nearly all the water descending from the large and valuable watershed of Susan River. This constituted the foundation of a magnificient enterprise which might readily hope to reclaim between 50,000 and 75,000 acres of land and create a community several times as large as the present population of Lassen County. The battle between natural irrigation and artificial irrigation seemed at that moment to have been won for the latter so far as the all-important water rights were concerned. The phrase "store and use" was interpreted by the plaintiffs to confer the right of diversion equally with that of storage, provided the stipulated minimum of 1,000 inches and 250 inches at different seasons, respectively, was permitted to flow down to the tules. A point of measurement was fixed, but no point of diversion was either fixed or forbidden, and the law gives large latitude on this score. From the day the judgment was recorded almost to the present time construction has gradually proceeded under the rights which the plaintiffs and their successors supposed this judgment had conferred upon them. Since it was rendered the system has twice changed hands, and on each occasion this stipulation was regarded as the most valuable item on the list of assets. Events have proved, however, that the most important judgment ever rendered in the history of Honey Lake litigation is open to attack. This is a matter of grave consequence not only because of the large investments which were predicated upon the judgment, but still more on account of the homes and farms since created and resting upon the same foundation.

THE BUILDING OF THE "COLONY DAM."

In November, 1897, the successors in interest of the plaintiffs in this case began the construction of a substantial dam at a point on Susan River 200 feet below the mouth of Willow Slough, which now conducts nearly all the waters of Willow Creek into the river. The dam is considerably above the old mouth of Willow Creek, which is now a dry channel except in seasons of unusual flood. To complete the dam and render it effective it was necessary to build extensive levees on the north side of the river and to provide outlets into a cross slough in order to relieve the pressure on the structure. A large outlet canal was constructed for a distance of about 4 miles. The work was mostly finished by the spring of 1898, the total cost being about $12,000.

Although the proposed construction had been widely discussed throughout the valley, both in the newspapers and in public meetings, the builders heard but little opposition to the project. Certainly no injunction was served upon them. As soon as it was attempted to put the new works into use, however, the farmers of the Tule district protested that the new dam interfered with their rights. They asked the court for an injunction restraining the use of the dam, and brought suit to have it condemned as a nuisance and removed. The case was argued on demurrer and decided in favor of the defendants. Pending the filing of a new complaint the Tule people appeared in force and removed the flashboards from the dam, claiming to act upon the advice of their attorney. The defendants replaced the flashboards, their opponents took them down, and the process continued for some time, varied with occasional threats of more aggressive action on both sides. The result was that the dam was never used, except for a few hours. The case was finally tried in July, 1899, and judgment, as condensed for this report, was rendered as follows:

> Declares dam near mouth of Willow Creek a nuisance and enjoins its maintenance by defendant, as it is now and has heretofore been maintained and used.

This decision was so unsatisfactory to both sides of the controversy that both appealed to the supreme court. The plaintiffs wanted the dam removed and the judgment ordered nothing of the kind. The defendants wanted their rights interpreted and to be told how, if the dam was not built in accordance with the stipulation, it could be made to accord with it, thereby giving them the benefits of the water to which they supposed they were entitled without inflicting injury upon their neighbors below. The decision shed no light on these questions. The dam was a nuisance, but it could remain. It could not, however, be maintained "as it is now and has heretofore been maintained and used." As we have already seen, it has practically not been used at all. Those who built it had thought that the actual use of the dam would furnish the real test as to its compliance, or failure to comply, with the letter and spirit of the stipulation.

The case is one of much importance to the irrigation industry of Honey Lake Valley. It is also interesting because of the light it throws upon irrigation law and practice in California, and the judicial decisions based thereon. For this reason it seems worth while to give the merits of the controversy, as they appeared in the testimony and otherwise, from the standpoint both of plaintiffs and defendants.

MERITS AND LESSONS OF THE CONTROVERSY.

A few months subsequent to the rendering of the stipulated judgment the plaintiffs in the case sold their interests in the system to Mr. Edward T. Purser. He carried on the work of construction over a period of four years, devoting his expenditure mostly to the increase of reservoir capacities. In 1897 he disposed of his interest to The Associated Colonies, a New York corporation. After a careful study of conditions existing in the valley, the officers of this company realized the startling waste of water resulting from the separate operation of many different ditches and the large gains which might be made by all concerned if the water supply could be handled as a whole. To this end they proposed to put their own system on the basis of a cooperative company, so that the ownership of the water and land might be forever united, and to invite the entire community to participate in the undertaking. Meetings were held throughout the valley and committees appointed to represent various interests and communities. The project was cordially approved by many of the oldest appropriators, the argument being that by consolidating all rights and works in one cooperative company it would not only be possible to administer the existing supply much more economically and harmoniously, but that all would be benefited in addition by the storage of waters which were being wholly wasted. The scope of the proposed operations was well evidenced by the makeup of the board of directors of the cooperative company. These represented the following towns and neighborhoods: Susanville, Johnstonville, Buggytown, Standish, Milford, Amedee, and the Tule district. It was believed that a board as representative as this would be able to protect the interests of all localities and avoid social friction and litigation, with resulting prosperity for the valley's irrigation industry as a whole. The subscriptions for the stock of the new company were encouraging in amount and character.

With every apparent sign of enthusiasm and good will the reorganized system set out upon its career. A definite programme of construction, looking to the gradual increase of the water supply and the irrigated area, had been worked out and discussed at all the public meetings. The first step in this programme was to build the dam on the lower part of Susan River to provide for the diversion and use of flood waters in accordance with the stipulation already quoted. The results of this first step have already been described in our account of the later lawsuit. It was not a case where all the virtue and all the justice lay with one side, and it may therefore be worth while to speak of the merit of the controversy as it appeared to the contending parties.

Those who built the dam supposed they had a right to take all the waters of Susan River, either by storage or by diversion, with the exception of 1,000 inches from March 1 to July 1, and 250 inches thereafter, which had been expressly reserved for the Tule district. It was clearly understood that the measurement must be made immediately above the mouth of Willow Creek. The employees of the company were instructed to treat Willow Slough as the true channel of Willow Creek for this purpose and to measure the river above the mouth of the slough, permitting the required amount of river water, together with the entire flow of Willow Creek, to pass the dam. The measurements of water at this point during the spring of 1899 are given in an earlier page of this report. They show that even in a year of considerable drought there was a surplus available for the dam and its new canal at that point. There was a reason of the highest engineering importance why the dam should be located below the mouth of Willow Slough. This reason is found in the fact that Willow Slough is a natural canal, furnishing a connection between the river and a system of proposed reservoirs on the north side of the valley. By making use of this natural canal the construction of an artificial waterway for a long distance, through a difficult country, was avoided. Since the California law distinctly provides that stored waters may be mingled with a natural stream and then taken out, and since there was no legal restriction governing the point of diversion, this engineering reason was regarded as conclusive as to the location of the dam.

On the other hand, it was recognized that the building of the dam at this point might be misunderstood, and that a structure so located might readily be used so as to inflict serious injury upon farmers living lower down on the river. But the enterprise was regarded as essentially a public undertaking. It had been organized with the approval and assistance of all elements of the community. It was believed that the dam could be operated in such a way as to benefit all and injure none, and it was expected that the result would be general confidence and respect for the enterprise. The dream proved Utopian. The dam, as built, intercepted the entire flow of Willow Creek. It might, then, be used to deprive the Tule settlers of every drop of water except 1,000 inches. In this case their homes and farms would be desolated and the fruits of many years' labor be lost. With the first sign of dissatisfaction the mischief-makers on both sides saw their opportunity. It was hinted to the Tule people that Willow Creek and Willow Slough were entirely different streams, and that if they received their quota of Susan River water as measured immediately above the mouth of the old creek they would have no cause to complain. As the tension increased the intention of the company to treat Willow Slough as the proper point of measurement assumed the proportions of a defiance and was later set up in the defense on behalf of the dam. Nothing further was needed to confirm the suspicion of the Tule farmers that their fortunes were menaced by the policy of the new company, and that they were face to face with a struggle for life. The foolish words were not all on one side. Those who sympathized with the Tule farmers hinted at the efficacy of dynamite, and the farmers themselves later attacked the dam and removed a part of it. Their attorneys sought to destroy the value of the former stipulation by asserting that the phrase "to store and use" limited the company's rights to simple storage and prohibited diversion. This interpretation they sought to narrow so that storage itself was limited to one or two reservoirs begun in 1893, and to the theory that even these could be filled and emptied but once each year. This would have meant the destruction of the foundation on which the entire enterprise was based. Thus on both sides the controversy became one of life and death. This was the unfortunate outcome of the cooperative effort to utilize the water supply in a manner to secure the largest measure of justice and prosperity for all.

The plan was based on common sense, but the laws did not permit of its realization. Had the stipulation been so definite that it could not be questioned, and had there been a system of public administration under which no works could be undertaken except with the approval of State authority, this costly and demoralizing incident would not be a part of the valley's history.

CONTRACTS OF IRRIGATION COMPANIES.

Contracts to furnish water have been extensively made in the basin by the various companies which at one time or another sought to develop the water supply. As most of these enterprises failed, there has been little litigation on the subject. But one interesting case may be cited which goes to show that the present laws and practice are no more favorable to this kind of development than they are to small private ditches.

In the case referred to the plaintiff was a farmer taking water from the principal irrigation system in the valley. In a year of general shortage, owing to the light snowfall in the mountains, he claimed that his crop had been materially diminished because the company had undertaken to oversell his supply. It was asserted in the complaint that only 1,600 acres had any legal right to receive water from the system, while over 4,000 acres were being served. No definite amount of water was promised by the contract. The expression was: "Sufficient water for the annual irrigation of the tract of land particularly described." There was therefore no means of bringing the matter to the test of actual measurement or of deciding what constituted "sufficient water," except by going into court.

The company answered in part by quoting the following provisions of the contract itself:

> It is understood and agreed that, if in any one or more years the supply of water in said irrigation system shall be inadequate for the proper irrigation of all the lands for which the party of the first part may have agreed to supply it, then in such case the priority of such grant and agreement shall give no priority of right as against those having similar agreements, although of later date; and in the event of such inadequate supply all parties having agreements similar to this with the party of the first part shall be entitled to receive water pro rata; that is, the party of the second part shall be entitled to receive the same quantity of water per acre for the land above described as others receive per acre for their lands and no more.

On this point the company offered evidence to show that the owners of over 6,000 acres had bought and paid for similar water rights prior to the plaintiff. One other material point in the contract was as follows:

> That it is understood and agreed, that, if from any cause the said irrigation system shall during one or more years be inadequate to furnish a sufficient supply of water to produce a crop upon said land of the party of the second part, the party of the first part shall not be liable for any damages which may result from such insufficient supply.

The judgment of the court in this case was as follows:

> Plaintiff has right to demand and receive from defendant sufficient water from its system to thoroughly irrigate all crops annually grown (on lands described). It is ordered that defendant furnish no water to irrigate any land in excess of 1,600 acres from its irrigation system in any year until plaintiff's lands are fully supplied with water. Defendant enjoined from furnishing water in excess of said acreage before mentioned. Seven hundred and fifty dollars damages and costs to plaintiff.

To the defendant company the provisions of the contract seemed very clear. In view of the decision, however, it would appear that the present law and the manner of its interpretation furnish very little protection for those who make investments of this character.

THE NEEDED REFORM OF CALIFORNIA LAWS.

The evils of the California irrigation laws, as clearly disclosed by the experience of Honey Lake Basin, may be briefly summarized as follows:

1. *The laxness of the method of appropriation.*—This results in the overappropriation of streams to a preposterous degree, in the posting of important notices in obscure places, in the keeping of public records difficult of access and almost wholly indefinite as to the actual status of existing rights, and in demoralizing and interminable strife between different users of water from a common source.

2. *The failure to ascertain the character and extent of water supplies by public authority.*—Without such official data there can be no safe foundation for further development and no intelligent appropriation of water for any purpose.

3. *The failure to assert public authority over the construction of irrigation works.*—This results in the building of dams, canals, and reservoirs which may be contrary to public policy and a menace to life and property.

4. *The failure to provide just methods for the distribution of water under public authority.*—This leads to bitter struggles among the neighbors to obtain sufficient water for the satisfaction of their rights as they understand them.

5. *The lack of any method of establishing the reasonable duty of water in different localities.*—Without an agreement on this subject there is no basis for an intelligent decision as to what constitutes "beneficial use."

6. *The confusion resulting from the recording of appropriations by counties rather than by streams.*—This is especially unfortunate in places where important streams flow from one county into another, but everywhere it is desirable to have the appropriations upon each stream brought together upon the records. The reason for this is so obvious as to call for no discussion.

7. *The failure to provide a method for settling disputes among water users less costly and more expeditious than a resort to the courts of law.*—In the petition to the Secretary of Agriculture, which resulted in the present investigation, it was well said: "Great sums have been lost in irrigation enterprises. Still greater sums are endangered. Water titles are uncertain. The litigation is appalling."

The foregoing enumeration does not include all the evils arising from the present laws. There is another class even more fundamental to be mentioned later. But every one of the evils so far mentioned may be cured by such a system of administration as exists in other States of the arid region. It seems strange that California, ranking first among her sisters in the irrigation industry, should be far behind States having less than one-tenth her population in this respect. The fact is due to the early predominance of mining over agriculture, as evidenced by the decision of Chief Justice Murray, which has been quoted. Mining diffused the spirit of speculation throughout the economic life of California. The peculiar conditions which surround the agricultural industry were not appreciated, and the people were to learn their needs through suffering and experience.

Turning from this Empire State of the West to Wyoming, we may bring into contrast with the California laws a system of administration which is not a theory, but a practice.

Wyoming came into the Union with an irrigation law which provided for a State engineer and a board of control, and for water divisions corresponding to natural hydrographic districts. A superintendent is placed in command of each district. These divisions are then organized into several subdivisions, with a water commissioner over each. In division No. 1 there are fourteen subdivisions; in division No. 2, six; in division No. 3, two; and in division No. 4, three. The four superintendents of the water divisions constitute the board of control, over which the State engineer presides. Thus the smallest ditch on the remotest stream in Wyoming is brought into close and intimate touch with the central authority at the capital of the State. Here complete records of all appropriations and all adjudications are kept, and to this same central authority must come all applications for new rights. No appropriation can become actually operative until the State engineer's office has passed upon it and determined that the water is available to meet the new demand. Not only so, but the same authority passes upon the works to be built, and must know that they are of proper character, and that the proposed construction will conform to public policy, before it will issue the necessary permit. It will be readily seen that such provisions eliminate at a stroke many evils which have furnished the basis for litigation in California and many risks which have overwhelmed irrigation enterprise with disaster. But this is by no means all the good accomplished by the Wyoming system of administration.

It is the business of the State engineer and his assistants to thoroughly explore the water resources of the State. Streams are regularly gaged, and the results shown by a system of charts and diagrams exhibiting the variations in the stream at different seasons of the year. Flood waters and storage possibilities are also closely investigated, and enterprises of this character may be undertaken with a degree of safety not possible when it is necessary to rely wholly upon the reports of private engineers. This thorough study of water supplies furnishes a foundation upon which appropriations may be based. Another very important feature of the Wyoming law is that which provides for the adjudication of rights on the basis of actual beneficial use. The constitution adopted when Wyoming was admitted to statehood provided for a careful review and readjustment of all appropriations, and compelled those who were using public waters to show that they were applying them economically and usefully, or to renounce their claim upon so much of them as they were wasting. Priority was scrupulously recognized, but waste was forbidden and efficient means taken to prevent it.

One of the most important reforms effected by the Wyoming law concerned the distribution of water. The commissioners in charge of the twenty-five subdivisions are placed in absolute authority on this score. They and their assistants are vested with police powers, and it is their business to patrol the canals and see that the law is rigorously enforced. There is here no opportunity for one neighbor to interfere with another's headgate. The water commissioner knows the appropriations which have been allowed and the order of their priority. He alone has any right to handle the headgates and direct the course of the waters. He is responsible for the delivery of the supply and for its measurement. Complaints seldom arise because very little has been left open to dispute, but when they do they are not filtered through the courts, but placed immediately before the board of control. This is a body composed of irrigation experts and practical irrigators who have been supplied with every facility required for the work of administration. There may be an appeal to the courts, but it is very seldom taken, since everybody knows that the board of control is best suited to deal with the subject and that the entire water system of the State is built on the foundations of eternal justice.

The settler who makes his home in Wyoming and the investor who places his money there both know at the beginning the matter and extent of their rights, and they know that these will have the fullest protection. In California neither the settler nor the investor can possibly know the precise nature and extent of his rights—they can only know that they are likely to be involved in lawsuits and that the final result must be the survival of the fittest, fitness being determined by the ability to meet the expenses of litigation. And yet the natural conditions for irrigation development are infinitely more favorable in California than in Wyoming. The difference is simply a code of laws. It would be moderate to say that if the Wyoming laws could be bodily transferred to the statutes of California the fact would be worth millions of dollars every year to the latter.

PRIVATE OR PUBLIC OWNERSHIP OF WATER.

In California, water is private property. Once appropriated, it may be used for any purpose to the extent of the ditch or flume constructed for its reception. It may be sold or rented. It may be used first at one place and then at another; first for one purpose and then for an entirely different purpose. It is absolutely the property of the person who acquires title to it, as much as his horse or cow, and the public has no more concern with it than with any other commodity belonging to a private individual, except that where water is appropriated for "sale, rental, or distribution" the public has retained the power to fix the rates at which it shall be disposed of. This would be unfortunate enough if it applied only to those who had acquired title under some semblance of beneficial use, but the California doctrine of private water ownership does not stop there. Riparian owners are entitled to "the natural and usual flow of all the water, unless where the quantity has been diminished as a consequence of the reasonable application of it by other riparian owners," and such "reasonable application" includes "a reasonable use of the waters of the stream for purposes of irrigation." True, one part of the State code says that "the right to the use of running water flowing in a river or stream or down a canyon or ravine may be acquired by appropriation." But another part of the code distinctly provides that the rights of riparian proprietors are exempted from the operations of this law of appropriation. In its decision of the famous case of Lux *v.* Haggin, from which the above interpretation of riparian rights is taken, the supreme court of California laid great emphasis upon the fact that the rights of appropriation conferred by the code could not and did not affect riparian rights as established by the English common law. The California statutes, and all the decisions based upon them, make riparian rights paramount to rights acquired by appropriation and actual beneficial use. This amounts to carrying the doctrine of private ownership to its last extremity.

The experience of other States and of all foreign countries has demonstrated that this doctrine is untenable in arid lands. It is recognized that water is a form of natural wealth, which in the best interests of society must never pass beyond public control. World-wide experience and world-wide authorities agree that there can be no private interest in water save that which inheres in actual beneficial use. The community has an interest in every drop of water which enters at the headgate or escapes at the end of the canal. This is so because in an arid land the extent of the water supply is the measure of the country's possible wealth and of its ability to support the social and economic structure. To a very marked degree water control must be socialistic in its nature. This has been recognized in the legislation and plans of administration adopted in other States and countries. Where the most enlightened laws prevail title to water rests not in individuals, but in the lands to which it was originally and perpetually dedicated. Land and water are treated as inalienable. The one can not be disposed of without the other. There can no more be traffic in water than in sunshine or air. All three are alike essential to the existence of human and vegetable life in arid lands. A monopoly of one of these elements would be as inimical to the public good as a monopoly of either of the others. Air and sunshine are diffused without human effort. Water must be controlled and directed, and since there is much less than enough to supply the demand there must be laws providing for the protection of those who have acquired the rights to its use. But these laws must recognize the paramount public interest and must see that it is distributed with the same scrupulous regard for the inherent rights of humanity as the scanty provisions of a besieged city. Such is the doctrine of the most enlightened communities which have dealt with irrigation. To hold to the private ownership of water is to say that an arid land shall remain a wilderness or that its people shall bear the yoke of servitude. The one result would be destructive of industry and commerce, the other of the best ideals of civilization.

All the evils of the California practice enumerated at the beginning of this section may be speedily cured by a proper system of administration, but the more fundamental evils arising from the vicious doctrine of private ownership of water can be reached only by heroic treatment. The only remedy suggested by the supreme court of the State is the assertion of the right of eminent domain, under which riparian titles could be condemned and taken for public uses upon payment of just compensation. While other methods might be suggested, a remedy even as costly as this would prove a good investment.

THE LARGER IRRIGATION PROBLEM OF THE BASIN.

While a good system of administration would eliminate nearly all friction and litigation among water users in Honey Lake Basin, and to that extent furnish encouragement for future enterprises, it would not of itself solve the large irrigation problem of the valley. There are now about 20,000 acres in cultivation under ditches. This is practically the limit of the area that may be reclaimed by small works depending upon the perennial flow of streams. The larger problem is concerned with the reclamation of a great area of sagebrush lands extending from the foothills of the Sierra Nevada Mountains to the neighborhood of Pyramid Lake, in Nevada. This district includes more than 200,000 acres of arable land. What portion of it would be actually susceptible of irrigation, in case the water supplies of the region were developed to their fullest capacity, has not been definitely determined, but the area which might be reclaimed under these conditions would make homes for many thousands of people and support a very considerable railroad and commercial traffic.

THE FAILURE OF PAST ENTERPRISES.

The opportunity which exists here for large enterprises has not failed to attract the attention of the public in the past. There have been several periods of active effort during the past twenty years. This is the significance of the vast claims which have been noticed in earlier pages of this report. The scene of these efforts has included all the large sources of water supply—the headwaters of Susan River, Eagle Lake, Balls Canyon, Long Valley, and Skedaddle Creek. A conservative estimate of the investment represented by all these undertakings would be $500,000, and perhaps double that sum would be no exaggeration if the interest accumulation were included. For all that expenditure not more than 5,000 acres are actually irrigated from the systems which were begun, so that it might be said that for each acre irrigated by these undertakings from $100 to $200 was spent in cash. In view of the fact that the average first cost of irrigating land throughout the arid region, as shown by the census of 1890, was $8.15 per acre, this would argue that there have been serious miscalculations or unusual disasters to contend with in Honey Lake Basin. Such is the actual fact. Of the many large enterprises projected or undertaken only one has anything substantial to show for the results. Even this is far from completion and groaning heavily under the burdens imposed by unfavorable conditions.

The failure of past enterprises was chiefly due to two facts. In the first place, everything was undertaken without sufficient knowledge, since the State has left its citizens wholly in the dark regarding the irrigation industry. Without scientific investigation of water resources and intelligent public supervision of projected works, the tempting opportunities for reclamation and settlement offered by the natural conditions of this basin proved simply an invitation to disaster. Large sums were expended in trying to get water from sources and by methods which were problematical at best. Costly earth dams were erected where they could not hope to withstand the first flood. The result was pecuniary loss for investors and disappointments and hardship for settlers. These misfortunes, which would have been prevented by a system of administration like that of Wyoming, gave the country a bad name and injured the entire community.

In the second place, it has proven extremely difficult to command large capital for the irrigation industry. This is due in part to the uncertainties arising from the California law, but yet more to the ill repute of irrigation securities in general. These enterprises require large sums and, even under the most favorable conditions, the returns are likely to be long delayed, since much time is necessarily consumed in establishing the industrial economy of a new country and bringing it to a point where it may pay regular dividends to capital. The results of private investment in this field have been such as to lead many conservative men to favor some form of public enterprise, though opposed to this method in other lines.

But in spite of past failures the rich lands of Honey Lake Basin must be reclaimed. The territory is needed for the homes of men and the desert must be made to give place to the field, the garden, and the orchard. It will be profitable to examine the several methods by which this might be accomplished and to consider which of these is best adapted to the situation.

THE WATER-RIGHT SYSTEM.

Nearly all the enterprises thus far undertaken in the basin have been planned on the familiar lines providing for the sale of water rights and the collection of annual rentals. The price of rights ranged from $5 to $10 per acre and the water rentals from $1 to $1.50 per acre. Those who planned companies in this way expected to recover their entire investment, and perhaps more, from the sale of water rights. In that event the annual rentals would pay dividends on fictitious capital besides meeting the maintenance charge. Pleasing as the plan looks on paper it has never produced the expected financial returns. It has now been swept away by the decision of Judge Ross, of the United States circuit court for the southern district of California, rendered in the famous San Diego case. The conclusion is that there can be no such thing as a water right in the sense that these companies and their consumers understood it. Landowners having property under an irrigation canal have an inherent right to demand water from that canal by tendering the price of it. This price must be fixed on the basis of reasonable interest upon the actual investment. The price is subject to review and revision by the county board of supervisors, who can not, however, fix it at less than 6 per cent nor more than 18 per cent interest on the investment. This would usually mean the minimum amount, which is hardly sufficient to tempt investment into this unpopular field. Furthermore, the provision for giving the supervisors the power to make the rates is open to many objections. It is hardly to be expected that Honey Lake Basin will be reclaimed by this method.

THE COOPERATIVE CANAL.

The cooperative company, chartered to furnish water exclusively to its own stockholders and operated with no expectation of dividends, is free from most of the objections which attach to private canals. Theoretically, at least, it supplies water at actual cost and imposes no hardships upon the consumers. But there is the same difficulty in commanding large capital, and it is gravely to be feared that the natural limitations of this method will not permit of its application to great undertakings. If the bonds of such enterprises could be readily floated at low interest, and if popular initiative could be trusted to evolve administrative methods equal to the needs of such a system, this would furnish a happy solution of the larger irrigation problems. But the truth is that both the capital and the management necessary for such undertakings are extremely difficult to command in cooperative enterprises. Where it is only a question of building a small local ditch the case is entirely different.

POSSIBILITIES OF THE CAREY LAW.

Oddly enough, California has thus far declined to accept the grant of 1,000,000 acres of arid public land offered by the Carey law enacted in 1894. The provisions of this act are much more favorable to irrigation development than the land laws which have been utilized in Honey Lake Basin—that is, the homestead law and the desert-land law. Under the Carey act, if supplemented with appropriate State legislation, the irrigable lands in Honey Lake Basin could be withdrawn from settlement. The State would then advertise for bids of construction companies desiring to build the necessary works to reclaim these lands. If the Wyoming example were followed, the construction company would look for its return to the sale of shares in the canal, which is based upon a cooperative basis. The price of the land would be fixed at 50 cents per acre. The State would fix the maximum price which could be charged for water shares. In Wyoming the maximum price fixed has varied from $10 to $16 per acre, so that the settler pays from $10.50 to $16.50 per acre for water and land. He is then joint owner in the irrigation works, and in the end the entire control passes into the hands of himself and his neighbors. This plan is a great improvement over the past methods from the financial standpoint. For all practical purposes, the entire tract of land to be reclaimed serves as the basis of security for the capital employed in the work. This is so because the land office will permit entries on this tract only from those who bring evidence that they have contracted for the purchase of shares in the canal. Thus, those who furnish the capital know that these lands can not be occupied except as the capital is repaid with whatever profit is permitted by the maximum price fixed by the State. In arriving at this maximum the State must take all contingencies into consideration and allow a price sufficient to reimburse the investment, otherwise no construction company will undertake the work. This plan also disposes of any vexations which attach to the homestead and desert-land laws and which have proven equally unsatisfactory to settlers and to irrigation companies.

STATE AND NATIONAL WORKS.

The most popular method of reclaiming these arid lands would be to have the National Government do the work and foot the bill. The theory that "a national debt is a national blessing" still widely prevails and is especially popular in the locality where it is proposed to expend the proceeds of the debt. If the policy of national works is to be adopted—and it must be admitted that it has gathered strength rapidly in recent years—it might well be applied to Honey Lake Basin. Even if goodly appropriations should be inaugurated at an early day, many beautiful valleys would have to wait long for their turn to come. Honey Lake Basin, hidden away in the pockets of the Sierras and off the line of transcontinental travel, might be expected to wait indefinitely.

State works of reclamation are quite as feasible as national works. So far as this locality is concerned, it is to be feared they are also quite as remote. Taxation of the entire State for the benefit of particular neighborhoods would meet with severe opposition. There is no doubt that it could be justified on the highest public grounds, but it requires a broad view to see that this is so, and broad views on this subject are not likely to be entertained in a State having so large a percentage of its population dwelling in localities only indirectly benefited by irrigation. State appropriations for storage enterprises, if realized at all, are likely to be expended in localities immediately tributary to important towns and transportation lines and not at the back door of the Sierra Nevada passes.

The conclusion is that Honey Lake Basin can only be reclaimed at an early day—say within ten or twenty years—as the result of laws which shall make investment safe and profitable, or which shall permit the people to tax themselves intelligently and effectively for their own benefit.

HOPE IN THE DISTRICT SYSTEM.

There has been no more notable failure in the history of California development than that of the irrigation-district system. It is perhaps also true that there is no better hope of salvation for many localities than the district system, if it be perfected in the light of experience. This brave effort to water the fertile lands of California and make them ready for a future population failed because of its administrative weakness and the difficulty encountered in raising promptly, and on favorable terms, the very large sums of capital required. It is perfectly feasible to eliminate both of these difficulties. A competent State engineer and board of control could pass intelligently on the need of works in a given locality and determine what should be their character and what their reasonable cost. The same official body could exert its influence and power in supervising the details of administration in each local district. It would be equally easy to surmount the financial difficulty. The State could well afford to pledge its own credit in support of the district bonds. It could sell its own bonds readily at 3 per cent interest, depositing in its treasury the 5 per cent bonds of the district and making the difference in interest pay all the expenses of administration. It would then be no longer necessary for the district financial agents to hawk their securities in the money markets of the world, selling them at all sorts of prices or exchanging them with contractors for doubtful consideration.

Both the money and the brains, which the district system has lacked, would thus be supplied. The State would risk nothing in the operation; the districts would gain everything. The burden of taxation would rest where it belongs—on those who are to receive the benefits. There would be no weary waiting of years for State or Federal schemes to materialize and to reach those remote neighborhoods which have few citizens and fewer outside friends. There would be no more heart-breaking private enterprises dealing with undertakings beyond their grasp.

Let us apply this principle to existing conditions in Honey Lake Valley. Suppose there are 150,000 acres to be irrigated without crossing the line into Nevada. A high estimate of cost when the work is done upon a large scale would be $5 per acre, or a total cost of $750,000 for work alone. It would be necessary to purchase, either by negotiation or condemnation proceedings, most of the existing canals and all riparian rights. Probably this could be done for less than $500,000; but it is well to add $250,000 for contingencies. This brings the sum total to $1,500,000, or a bonded indebtedness of $10 per acre. This debt would rest not alone upon the agricultural lands, but also upon all other real property in the district to be benefited by irrigation and the growth of population. The annual interest charge would be $75,000, to be collected from all the lands at the rate of 50 cents per acre. Another 50 cents would probably meet the cost of administration, making the annual assessment for all fixed charges $1. Under the district law, as recently amended, districts may simply pay interest for the first twenty years, and begin the accumulation of a sinking fund with the twenty-first year. The bonds run forty years, so that there is another twenty years for the payment of the principal of the debt. The debt of $10 per acre can be retired at the rate of 50 cents per acre each year, beginning with the twenty-first, which, added to the fixed charges, calls for $1.50 as the total assessment. This could impose no hardship upon the landowners, especially if the national laws be revised so as to cut down the entries to 40 acres, or to 80 acres, at the most.

In the foregoing figures liberal allowances have been made for each item. It is quite possible that the debt could be kept down to $7.50 an acre, or even $5 per acre. The entire construction fund need not be expended at one time. The situation is peculiarly favorable to the gradual extension of works. They could be extended each year to meet the growth of settlement, and the money not employed in the works could be placed at interest so as to relieve the taxpayers of that portion of the burden. The manner in which settlers have rushed to the valley when large works have been projected in the past, and the fact that there is perhaps not one instance of failure on the part of farmers who have actually had water for their land, go far to prove that under such a system of public works the people could cheerfully meet the financial demand which would be made upon them and realize satisfactory returns for themselves. Of the various methods suggested for reclaiming Honey Lake Basin, the district system, with such revision as has been suggested, is probably the best.

CONCLUSIONS.

After this extended study of the conditions presented by Honey Lake Basin, and of the operation of water and land laws, State and national, we are prepared to suggest some of the conclusions to which we are inevitably led.

In the first place, it is plain that here is a region now sparsely populated, and that sparse population contending among themselves for the precious water which is the lifeblood of their homes and farms, which might readily sustain tens of thousands.

In the second place, it is equally plain that development has reached and perhaps overstepped its limits under existing laws and methods.

If, then, there is to be progress in the future, and if the potentialities of this splendid valley are to be realized and placed within the reach of those who need them, the laws which now operate to repress and discourage enterprise must be changed and the measures essential to larger progress must be provided.

To a very large extent the work of reform and of constructive legislation which is needed is wholly within the power of California itself. There are important things to be done by the National Government, but these are comparatively simple, and would naturally follow upon the adoption of a vigorous State policy. The most important steps that might be suggested to the State are these:

1. *Creation of the office of State engineer.*—The duty of this official should be as follows:

(*a*) To make measurements and calculations of the discharge of streams from which water shall be taken for beneficial purposes, beginning with streams most in use.

(*b*) To collect facts and make surveys to determine the most suitable location for constructing works for utilizing water, and to ascertain the location of the lands best suited for irrigation.

(*c*) To examine reservoir sites and report to the State all facts ascertained, including, wherever practicable, estimates of the cost of proposed irrigation works and improvements.

(*d*) To make plans looking to the apportionment of the State into several grand divisions based on hydrographic lines as a foundation for a system of administration.

(*e*) To make annual reports to the governor covering the operations of his department and recommendations for needed legislation.

The State engineer should have power to employ such assistance as he may need in the performance of his duties.

2. *Creation of board of control.*—This body should consist of the superintendents of the several grand hydrographic divisions. The duty of the board should be as follows:

(*a*) To make regulations governing the distribution of water on the various streams of the State.

(*b*) To appoint water commissioners, with police powers, to supervise the distribution of water in accordance with the regulations.

(*c*) To cooperate with the State engineer in the general work of administration

(*d*) To hear and pass upon all complaints arising from the administration of the law in the various divisions of the State. The decisions of the board of control would be subject to review by the courts.

3. *Modification of riparian rights.*—The best use of the water resources of California demands the modification or complete abolition of the doctrine of riparian rights and the theory of private ownership in water apart from the right of use.

This could be accomplished by new legislation designed to facilitate condemnation proceedings, and perhaps to make provision from the public treasury for the purchase of riparian rights and the dedication of waters so obtained to public uses. It would be far more satisfactory, however, to lay the ax at the root of the evil by changing the constitution of the State. The following quotations from the constitution of Wyoming are of interest in this connection:

> Water being essential to industrial prosperity, of limited amount, and easy of diversion from its natural channels, its control must be in the State, which, in providing for its use, shall equally guard all the various interests involved.
>
> The water of all natural streams, springs, lakes, or other collections of still water within the boundaries of the State are hereby declared to be the property of the State.

These constitutional provisions, supplemented by wise laws of appropriation and administration—laws which recognize no right except the right of beneficial use and which join water and land inalienably and perpetually—furnish the only true and satisfactory basis for the control of water under the theory of public ownership. It would require at least two years to effect this sweeping change in California institutions, and perhaps much longer. In the meantime the laws of appropriation could be amended and improved, the system of administration organized and set at work, and the scientific study of water resources far advanced.

4. Improvement of the district law.—This should be accomplished in two ways, as follows:

(*a*) By having the State guarantee the bonds of such districts as shall have been authorized, after due investigation, by the board of control.

(*b*) By making the administration of such districts subject to the supervision of the State engineer and board of control.

5. Acceptance of the land grant provided by the Carey act.—This would enable the State to select 1,000,000 acres of arid public land and to make regulations of its own looking to its reclamation and disposal to settlers. There are many places in the State where the acceptance of this grant, if supplemented by appropriate legislation, would contribute to the solution of the irrigation problem.

In addition to the State legislation suggested in the foregoing, it is very desirable that national action should be had for the protection of the forests and the reform of existing land laws. The amount of land which settlers may acquire from the public domain for irrigation should be reduced. Eighty acres are sufficient in any part of the State, and 40 acres would be a better unit in most localities.

Under the existing laws of State and nation, Honey Lake Basin is practically bound hand and foot. There is an abundance of land and of water. There is an insistent and growing demand for their use. But there can be neither peace nor progress until the laws governing the appropriation and control of water and the use of the public domain shall have been revised and enlarged so as to meet the peculiar needs of the situation. When this has been accomplished real progress will begin, and never cease until this valley and the rich natural resources surrounding it shall be fully developed. Then a region which is now mostly a wilderness will be crowded with the homes of men, and the semibarbarism of the frontier will have given place to a real civilization.

FEATURES AND WATER RIGHTS OF YUBA RIVER, CALIFORNIA.

By Marsden Manson, C. E., Ph. D.

WATERSHED OF YUBA RIVER.

Yuba River is a tributary of Feather River, entering this latter stream at Marysville, 30 miles above its mouth (Pl. VIII). The Yuba drains about 1,357 square miles of the western slope of the Sierra Nevada, comprising portions of Sierra, Nevada, Plumas, and Yuba counties. The extreme length of the watershed is about 60 miles and the extreme width 36 miles; in addition to this length are about 11 miles of channel in the valley between the foothills and Feather River. In size Yuba River is fourth in the Sacramento Valley. Its extreme low-water discharge is about 360 cubic feet per second;[1] mean water discharge 1,500, and flood discharge 26,000 cubic feet per second.[2] The river for the lower 10 miles of its course in the foothills is filled up with hydraulic mining débris estimated at many millions of cubic yards, and is between levees which have been raised from year to year to meet the filling up of the area between them. The channel in the lower foothills has been filled more than 100 feet deep with cobbles and gravel. The channel of the river from the foothills to the mouth, at Marysville, lies over a surface recently built up of gravel, sand, and clay from the mines above. The channels are irregular and change from winter to winter, and sometimes during the summer.

It is therefore impracticable to establish low-water gaging stations which would serve for more than one summer and fall, and which would be suitable for winter or flood-stage gagings. The changes in the bottom and in the positions of the channel are so great that gagings at the flood stages of the river would be unsatisfactory, and, if undertaken from boats, highly dangerous, if not impossible.

Its drainage basin is subdivided into five smaller ones, namely: The North Fork, with a drainage area of 491.6 square miles; the Middle Fork, with a drainage area of 218 square miles; the South Fork, with a drainage area of 360 square miles; Deer Creek, with a drainage area of 89.6 square miles; and Dry Creek, with a drainage area of 105.5 square miles. In addition to these areas, 92.5 square miles drain into the main stream above the 100-foot contour.

Dry Creek joins the river from the north just as it leaves the foothills, the others having united in the mountains. The forks are perennial in flow, but the discharge of the two creeks named becomes insignificant in the late summer and early autumn.

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[1] This is not as small as the natural discharge would be. The large mining companies, North Bloomfield, Milton, Eureka Lake, the South Yuba Water Company, and other companies store quite large volumes of water during the winter and spring months, the use of which during periods of low water forms a considerable portion of late summer and early autumn discharge.

[2] Extreme flood discharge estimated by Mr. Hubert Vischer, assistant engineer, United States Engineer Corps, at 125,000 cubic feet per second. House Doc. No. 431, 56th Cong 1st sess., p. 12.

The Sierra foothills as they merge into the valley have an elevation of about 100 feet above tide. The watershed rises gently in rounded and broken mountains to the crest of the Sierras, which at the headwaters of the Yuba has a mean elevation of about 8,200 feet, with peaks rising to 9,100 feet. From Mount Lincoln, a point common to the watersheds of Yuba, American, and Truckee rivers, to some 2¼ miles northeast of Mount Webber, the summit of the Sierras divides the watershed of Yuba River from that of Truckee River, which discharges into Humboldt Basin. Farther on beyond Mount Webber there is a secondary crest which divides the watersheds of Yuba and Feather rivers, the watershed of the latter stream reaching farther east to a less elevated divide, in which the passes are lower than those in the easterly crest.

PHYSICAL FEATURES AND GEOLOGY.

The western and lower portions of the drainage area are slates and kindred rock, very much eroded and merging into gravel and alluvial deposits of the great valley of California. The upper portions are principally lava and granites. All are deeply eroded, particularly the slates and lavas. Some idea of the magnitude of these erosions is gained when it is considered that the great valley of California has required at least 4,000, and possibly 6,000, cubic miles of denuded materials to fill it to its present level, most of which has come from the Sierras.

A stratum of serpentine traverses the watershed of Yuba River in a direction generally parallel with the crest of the Sierras. It is intersected by the North Fork at Goodyears Bar, by the Middle Fork near Moores Flat, and by the South Fork just east of Washington, and leaves the drainage basin of Yuba River and passes near Towles station, on the Central Pacific Railroad.

This stratum is generally softer and more easily eroded than adjoining strata. The canyons of the various forks are therefore upon lighter grades through it than immediately above and below, and the canyons are generally wider. This softer material also controls the loci of longer and more deeply eroded tributaries, which afford approaches to the main canyons for roads and trails.

This stratum is of further interest since it is the dividing line between the auriferous strata in the watershed. To the west of it the mines are more extensive and more reliable, the occurrences of gold-bearing rock to the east being irregular and difficult to trace.

The topographic features of the drainage basin of Yuba River and those of adjacent basins can not be understood without a brief outline of certain occurrences in the geological history of the region.

The Sierras as a mountain range antedate Tertiary time. The drainage lines and features of much of the early topography north of the Tuolumne River were blotted out during the Tertiary era by an overflow of lava, basaltic in some instances, but principally mud lava in vast sheets, carrying bowlders of all sizes and shapes, cobbles, and gravel. The features established by this overflow can now be traced only partially, as far into and through these sheets Glacial and recent erosions have carved a new set of channels and established a new set of topographic features. Upon the disappearance of the Glacial period modern rivers carved out new channels upon lower lines than the early rivers and intersecting these latter at variable angles. Being lower, they have afforded the outfall for the hydraulic mining operations

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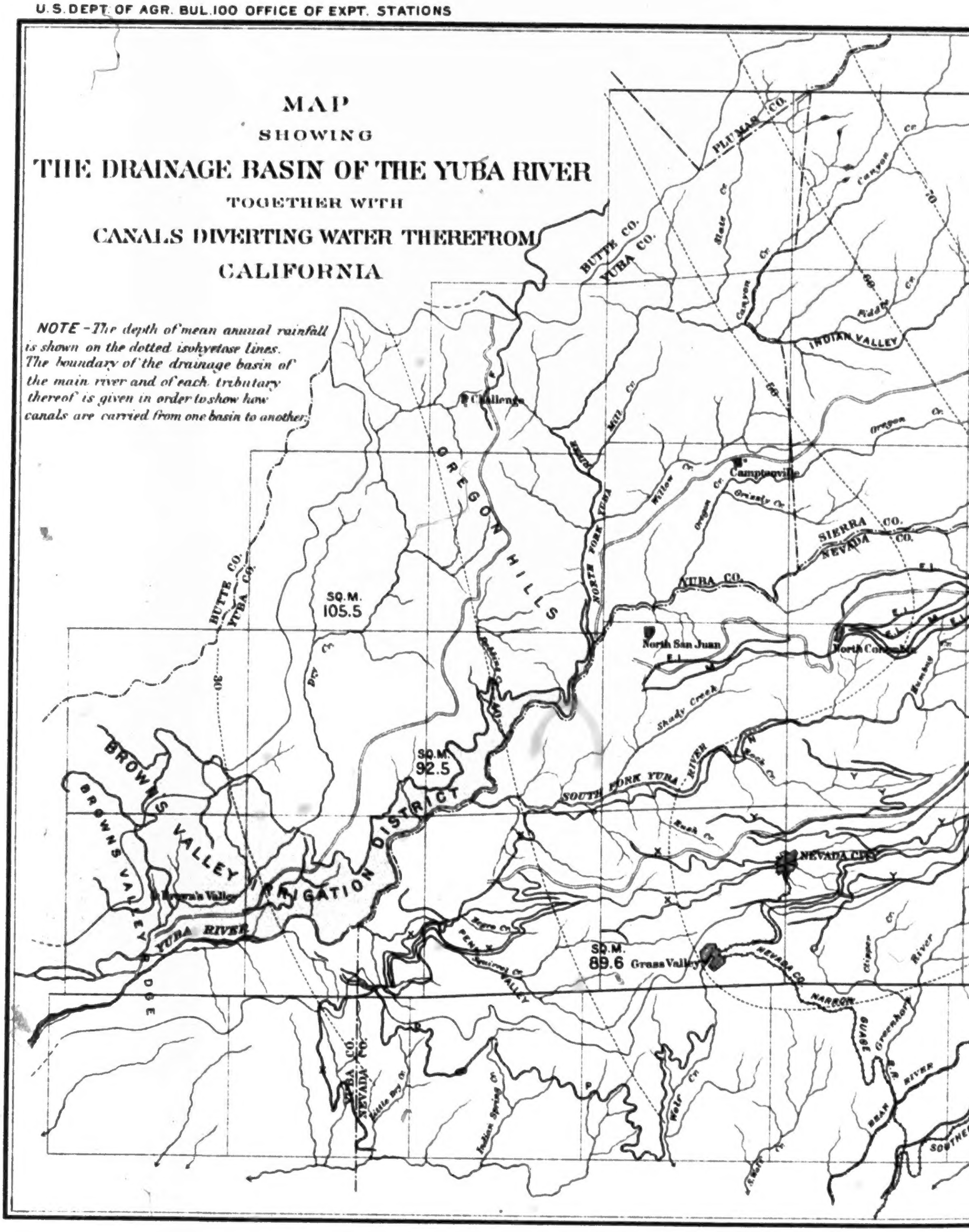
C

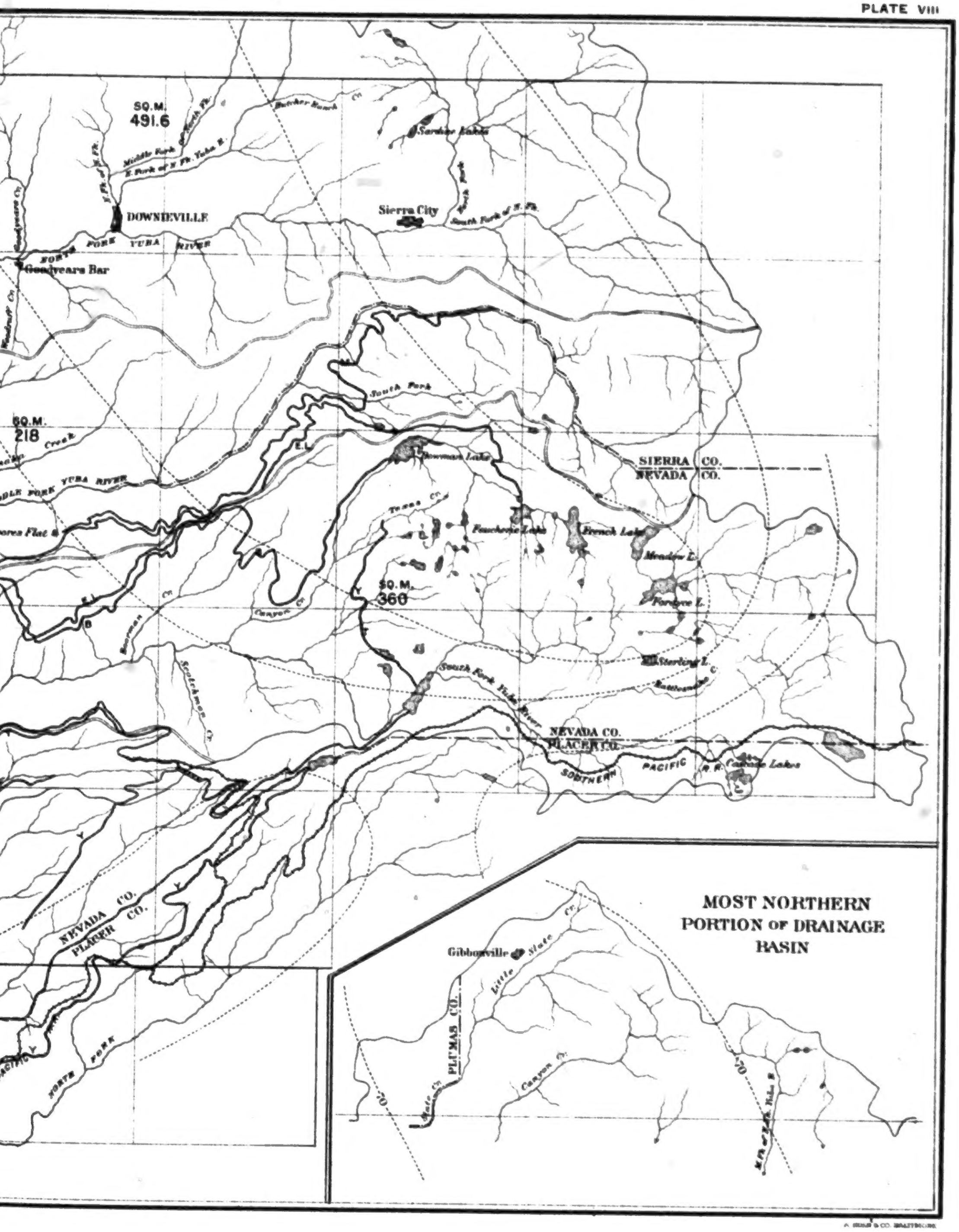


MAP
SHOWING
THE DRAINAGE BASIN OF THE YUBA RIVER
TOGETHER WITH
CANALS DIVERTING WATER THEREFROM
CALIFORNIA

NOTE – The depth of mean annual rainfall is shown on the dotted isohyetose lines. The boundary of the drainage basin of the main river and of each tributary thereof is given in order to show how canals are carried from one basin to another.

PLUMAS CO.
BUTTE CO.
YUBA CO.
State Cr.
Canyon Cr.
Fiddle Cr.
INDIAN VALLEY
Mill Cr.
Oregon Cr.
Challenge
OREGON HILLS
NORTH FORK YUBA
Willow Cr.
Camptonville
Grizzly Cr.
SIERRA CO.
NEVADA CO.
YUBA CO.
BUTTE CO.
YUBA CO.
SQ. M. 105.5
North San Juan
North Columbia
Dry Cr.
30
Shady Creek
SQ. M. 92.5
BROWNS VALLEY IRRIGATION DISTRICT
SOUTH FORK YUBA RIVER
Rock Cr.
BROWNS VALLEY RIDGE
Browns Valley
Rush Cr.
NEVADA CITY
YUBA RIVER
PENN VALLEY
Squirrel Cr.
SQ. M. 89.6
Grass Valley
NEVADA CO.
NARROW
Clipper Cr.
River
Greenhorn
RIDGE
YUBA CO.
NEVADA CO.
Little Dry Cr.
Indian Spring Cr.
Wolf Cr.
BEAR RIVER
SOUTHE

PLATE VIII


SQ.M. 491.6
Butcher Ranch Cr.
Sardine Lakes
Middle Fork
E. Fork of N. Fk. Yuba R.
DOWNIEVILLE
Sierra City
North Fork
South Fork of N. Fk.
Goodyears Cr.
NORTH FORK YUBA RIVER
Goodyears Bar
Woodruff Cr.
South Fork
SQ.M. 218
Creek
MIDDLE FORK YUBA RIVER
Moores Flat
Bowman Lake
SIERRA CO.
NEVADA CO.
Texas Cr.
Faucherie Lake
French Lake
Meadow L.
Fordyce L.
SQ.M. 360
Canyon Cr.
Bowman Cr.
Scotchman Cr.
Sterling L.
Rattlesnake Cr.
South Fork Yuba River
NEVADA CO.
PLACER CO.
SOUTHERN PACIFIC R.R.
Cascade Lakes
NEVADA CO.
PLACER CO.
NORTH FORK
MOST NORTHERN PORTION OF DRAINAGE BASIN
Gibbonville
Little Slate Cr.
PLUMAS CO.
Slate Cr.
Canyon Cr.
CO.
CO.
N. Fk. of N. Fk. Yuba R.

A. HOEN & CO. BALTIMORE.

conducted in the deposits left in the beds of the earlier streams. Some of the materials left in the early channels were also subjected to Glacial erosion and transportation. These processes doubly concentrated the gold in the original strata and made lines of Glacial flow and modern streams particularly rich just below their intersections with the early rivers.

There have been, therefore, three sets of topographical features:

First, the earlier topography, established by the upheaval and partial denudation of the range.

Second, that established by the lava outburst and succeeding erosion.

Third, that produced by Glacial and post-Glacial erosion, which is cross carved and cut into the preceding systems. In some instances one of these systems remains intact, in others two appear, whilst in rare instances remnants of the earlier systems make up parts of the features now found.

The combinations of these topographical types are found at the head of Bear River. This river heads 17 miles west of the summit of the Sierras, the headwaters of the North Fork of American River and those of the South Fork of Yuba River reaching beyond those of Bear River to the summit of Mount Lincoln.

The upper one-third of the drainage basin of the South Yuba was the gathering ground for a glacier. This glacier, instead of following the channel of that river through the tortuous, deep, and narrow channel which turns northwest through 110 degrees, plowed its way in a direct course through the lava ridge and eroded Bear Valley, in which Bear River heads.

Upon the disappearance of the ice age, Yuba River took the northerly course along a deeply eroded channel, leaving a portion of its Glacial channel below this bend for Bear River. This river therefore occupies a channel far larger than its feeble forces could have excavated. The topography in this region consists of three types. Yuba River below the bend probably occupies a very old channel. The remnants of the mud-lava overflow form the ridges on either side of the Glacial gap at the head of Bear River, whilst this gap and the headwaters of the South Yuba were shaped by Glacial action.

The glacial gap eroded through the lava ridge is only a few hundred feet above the present bed of the canyon of the South Fork, and affords an easy line for the diversion of its waters into the basin of Bear River, down both sides of which are important ditches.

The middle and upper portions of the watersheds of the three forks are materially different. The North Fork rises in lavas which vary much in composition and hardness, but which generally afford a deep soil for timber and shrub growth. The Middle Fork rises in similar lavas and in granite. The mean elevation of the crest of the Sierras at the head of these forks is about 8,200 feet. The main and tributary streams fall rapidly, and their canyons head well up into the mountains. The sides of these canyons are covered with timber and brush, which, with the deep soil, retain the moisture for numerous perennial springs. This is particularly the case with the North Fork, making it a reliable and constant stream. The mean annual precipitation upon these watersheds is about 54 inches of snow and rain. Warm rains on soft snow sometimes give a high flood run off, but snow remains on the higher peaks until midsummer. Reservoir areas are not numerous, and will be mentioned later.

The headwaters of the South Fork lie upon a broad granite surface, into which the streams have not cut deeply until the main stream reaches a point 16 miles from the summit, where it drops rapidly into a deeply eroded canyon. The eastern or upper edge of the drainage area has a mean elevation of about the same as the other forks, but the 5,000 feet contour is about 20 miles to the westward. This broad surface has been denuded by glacial action, and the harder nature of the granite has not permitted a deep soil to form. The area, therefore, is less heavily timbered than the drainage areas of the other two forks, and its accessibility has caused it to suffer more severely from the ax of the lumberman.

This topography gives a broader and more gently sloping surface than characterizes the headwaters of other Sierra streams. This surface is marked by nearly one hundred glacial lakelets and valleys, affording many excellent reservoirs which have been or are being utilized. This elevated watershed receives a mean annual precipitation of 60 inches, most of which is in the form of snow, the slow melting of which maintains the discharge of tributaries until June or July. This feature and the development of storage make the South Fork of the Yuba River a highly valuable and reliable source of water supply.

NATURE, ORIGIN, AND ACQUISITION OF WATER RIGHTS IN THE BASIN OF YUBA RIVER.

Water being a necessity in all forms of mining operations, the right to take and use it was recognized in the earliest stages of mining operations in 1849.

At that time all lands, except those held under the Spanish and Mexican grants, were part of the public domain, and riparian rights were bounded by the summits of the ridges which divided and subdivided the various watersheds. The grants had been made under the laws of Mexico and Spain, which laws did not contain nor recognize the riparian rights of English common law. The United States in the treaty of Guadalupe-Hidalgo undertook to guarantee and to protect the owners of these lands in the rights which they had acquired and enjoyed, but it did not endow these lands with rights they did not have. The riparian rights attachable to the public domain (if such rights were attachable) had the limits above set forth.

Upon the discovery of gold in 1848 great numbers of miners settled upon the public domain, and finding no laws by which they could acquire either the mines or the water with which to operate them, proceeded to establish equitable regulations to supply the deficiency. In September, 1850, the State of California was admitted into the Union, and its legislature found in existence and application the customs, usages, and regulations of the miners, and these customs, usages, and regulations established in the various camps were the beginnings in the United States of the right to divert and use water. This right was first recognized by legislative action in April, 1851, as follows:

Proof respecting mining claims.

> In actions respecting mining claims, proof shall be admitted of the customs, usages, or regulations established and in force at the bar or diggings, embracing such claims; and such customs, usages, or regulations, when not in conflict with the constitution and laws of this State, shall govern the decision of the action. (Stats. Cal., 1851, p. 149.)

These customs, usages, and regulations were in various forms, but one essential and fundamental principle was embodied in all, namely, the right to appropriate, divert, and use water. Possible conflicts in the application of this right were guarded by clauses providing that priority of claim and diligent prosecution of work were essential. Abuses were guarded against by clauses which required a claimant to make good his claim by actual use, and limiting his claim to the volume of water actually used. Abandonment was recognized as a forfeiture. Thus by nonuser extravagant claims to water were held in check in whole or in part.

Under these principles there were laid out and constructed extensive water storing and diverting works. The necessity for large volumes of water at points remote from streams was so great that water from one drainage basin was diverted into or carried across an adjacent basin. The claim to water for mining purposes grew into a claim to water alone, and individuals and corporations undertook to appropriate, store, and supply water, not only for their own properties, but for others. The riparian right was thus practically set aside, and the prime necessity for water for mining gave full sanction to this action.

This harmonized with the law and practice of water appropriation which had previously existed under Spanish and Mexican rule, and which had been handed down from Roman law through these channels. But it was radically at variance with the riparian-right principles which existed in the common law of England, and which had been embodied in the codes of the several States.

These common-law principles came to this country as a "precious heritage," and found proper and easy lodgment in the codes of the Eastern States, where climatic conditions are about the same as those in England, and where the mean annual rainfall is from 30 to 50 inches, and drainage more essential in agricultural operations than irrigation. But in the arid and semiarid States and Territories the adoption of these principles in so far as they affect water supply has been done without due consideration, and leaves the law with no rational and philosophic basis and opposed to the necessities of the country. These principles are adopted in California as follows:

An act adopting the common law, passed April 17, 1850:

> The common law of England, so far as it is not repugnant to or inconsistent with the Constitution of the United States or the constitution or laws of the State of California, shall be the rule of decision in all the courts of this State. (Stats. Cal., 1850, p. 219.)

The statutes of 1899 contain the following:

> SEC. 4468. The common law of England, so far as it is not repugnant to or inconsistent with the Constitution of the United States, or the constitution or laws of this State, is the rule of decision in all the courts of this State.

From the above beginnings of the right to appropriate water the laws of California were gradually perfected, and they now prescribe the mode by which the waters flowing in a river or stream, or down a canyon or ravine, may be acquired by appropriation.

These laws prescribe that the appropriation must be for some useful or beneficial purpose, the rights to which are voided by nonuser. (Civil Code of California, sections 801, sub. 5, and 1410, 1415, 1416, 1417, 1418, 1419, and 1420.)

These provisions of the law are reenforced by others which favor the appropriators and users with the right to use natural channels as conduits and with the right to change the place of diversion, provided no injury be done thereby.

Rights and properties acquired under these laws are protected by penal laws. (See sections 499 and 592 of the Penal Code of California.)

On July 26, 1866, or fifteen years after State recognition of this new right, it was embodied in the United States Statutes as section 2339 of the Revised Statutes of the United States, as follows:

> Whenever, by priority or possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of the courts, the possessors and owners of such vested rights shall be maintained and protected in the same, and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; and whenever any person in the construction of any ditch or canal injures or damages the possession of any settler on the public domain, the party committing such injury shall be liable to the party injured for such injury or damage.
>
> SEC. 2340. All patents granted or preemptions or homesteads allowed shall be subject to any vested and accrued water rights or rights to ditches and reservoirs used in connection with such water rights as may have been acquired under or recognized by the preceding section.

The common-law principles of riparian rights thus came into conflict with the practice and law existing previous to the acquisition of the country; with the customs, usages, and regulations established by the miners upon the sound and philosophic basis of necessity, and with the incorporation of these into State laws and into the Revised Statutes of the United States.

The question of riparian rights came before the supreme court of California, in Lux *v.* Haggin (69 Cal., 255), and the following is the interpretation by a majority of the court:

> By the common law as administered in this State, the right of the riparian proprietor to the flow of the stream[1] is inseparably annexed to the soil, and passes with it not as an easement or appurtenance but as part and parcel of it. Use does not create the right and disuse can not destroy or suspend it. The right in each extends to the natural and usual flow of all water unless when the quantity has been diminished as a consequence of the reasonable application by other riparian owners for domestic purposes, for watering stock, and for irrigation; what is such reasonable use is a question of fact and depends upon the circumstances appearing in each particular case.

The citizens and industrial enterprises of this State are thus in the anomalous position of having to operate under contradictory laws. On one side the common-law principles of riparian rights have been ingrafted into the code without defining whether these principles should apply to the low-water discharge of streams, to flood discharge, or to some intermediate stage. On the other hand, the antagonistic principle of appropriation of water has been introduced, and is the basis of extensive industries, and which permits the citizen to lay claim to any amount of water he may deem fit, limiting his legal rights to the capacity of the works he may construct.

As a result, upon nearly every stream in the State has already sprung up or will spring up a vexatious series of lawsuits. The questions involved must be settled upon the basis of facts and testimony of each particular case, no one type of principles being applicable to all cases. The matter can not, therefore, be settled by legislative enactment, although judicious laws will tend toward system and wise supervision will adjust some of the impending legal troubles and prevent future conflicts. But most of the discrepancies and disagreements must, in the language of the supreme court of the State, be settled "upon the circumstances appearing in each particular case." It may be possible by legislative action or legal interpretation of the existing laws to restrict the riparian right to low-water discharge, leaving flood waters for appropriation and storage. But the riparian right can not be set aside by law, as it is "inseparably annexed to the soil, not as an easement or appurtenance, but as part and parcel of it. Use does not create the right and disuse can not destroy or suspend it."[1]

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[1] It would be much better for the State if the court, instead of the words "flow of the stream," could have said, "the use of the water is inseparably annexed to the soil."

CLAIMS FILED ON YUBA RIVER AND ITS TRIBUTARIES.

Claims to the waters of Yuba River and its tributaries are recorded in the three counties drained by that river—Nevada County, at Nevada City; Sierra County, at Downieville; Yuba County, at Marysville.

Nevada County claims are recorded in three volumes of Mining and Water Claims. Subsequent to 1872 there is a separate volume of Water Claims. County records prior to 1856 were destroyed by fire, and the right to some of the oldest and most valuable properties rests upon prescription and evidence. The total number of recorded claims is 358.

Water rights in Sierra County are kept in six volumes known as Volumes A, B, C, D, E, and F of Bank and Water Claims, and subsequent to 1895 a seventh volume, Book G, Water Claims.

The claims recorded aggregate about 3,000. The attorney who examined this matter reported that it would take about forty days' work to transcribe them, and the transcript would be of little value for the following reasons:

First. Since most of the early claims were taken up for mining purposes only, and as this water was returned to the stream, it did not really impair the volume of water.

Second. The very great majority of these claims have long since been abandoned and are dead.

Third. Many of these claims were notices of intention only, and nothing was done to carry out the intention.

Fourth. Many perfectly valid water rights exist which have not been recorded, the rights having been acquired by prescription.

These claims were, therefore, not copied. Those upon the assessor's list number 90.

Yuba County water records are kept in Volumes I and II, Miscellaneous Records; Volumes I and II, Prescriptions, and Volume I, Water Rights (since 1872).

In these volumes are recorded 329 claims, many of which are abandoned.[2]

STORAGE OF WATER IN THE BASIN OF YUBA RIVER.

The precipitation upon the drainage basin of the Yuba River is dependent upon the southerly or winter extension of the north temperate rain belt. During the summer months the more northerly position of this belt leaves California in the comparatively rainless region between the north temperate and arid equatorial rain belts. The rains and snows, therefore, fall from October to April, with little or no rainfall of moment from May to September. The streams during these months, therefore, depend upon natural or artificial storage. Natural storage is had by snow and by the slow run off of water retained in afforested and brush-covered soils. Artificial storage has reached a very efficient stage on the South Fork.

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[1] 69 Cal., 255, previously quoted.

[2] An abstract of these claims was furnished with this report. It is too long to be inserted.

The mean distribution of precipitation is shown on the map accompanying this report and also on the section which shows the increase due to elevation (fig. 1). This ranges from 20 inches at Marysville, in the valley, to 70 inches at the summit of the Sierras.[1]

Snow storage of water is depended on during the latter part of April and into July. The run off until June is superabundant for all purposes, but begins to fall below the necessities of dependent industries from July until autumnal rains. Snow storage has not been made a subject of extended observation, except by Mr. W. F. Englebright, the chief engineer of the South Yuba Water Company, through whose courtesy the writer is enabled to present the following instructive diagram of the rate of accumulation, depth, and rate of melting of snow at Lake Fordyce (fig. 2). This lake has an elevation of 6,500 feet above tide level, and is in a region over which annual precipitation in melted snow is 70 inches.

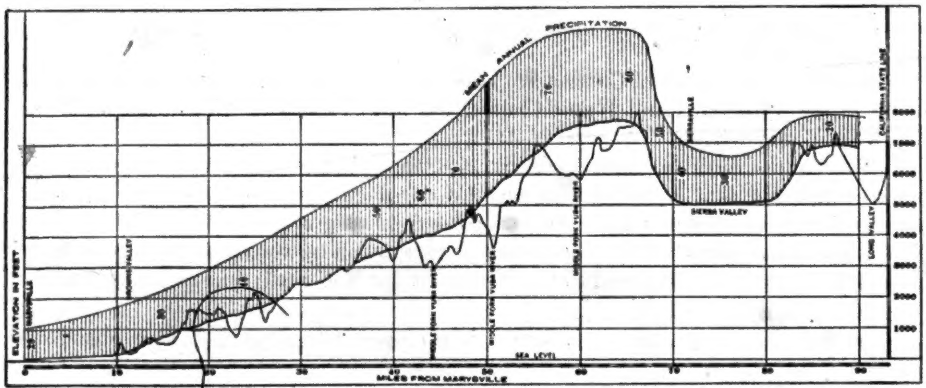

FIG. 1.—Diagram showing variation in precipitation with altitude.

The variation in depth of snow in different seasons and the effect of late cold seasons are distinctly shown on the diagram.

Snow begins to accumulate late in November and reaches its maximum depth of packed snow in March. The lower readings on the gage rod, following higher readings during the winter months, generally indicate a packing of the snow. Melting begins in March and continues quite regularly until the middle of June or early in July; short storms during April and May cause offsets in the curve, which resumes a parallel line. A series of cold and heavy storms in April, 1896, caused the snow to last until July 5, while the clear warm spring of 1897 caused it to disappear on the 7th of June.

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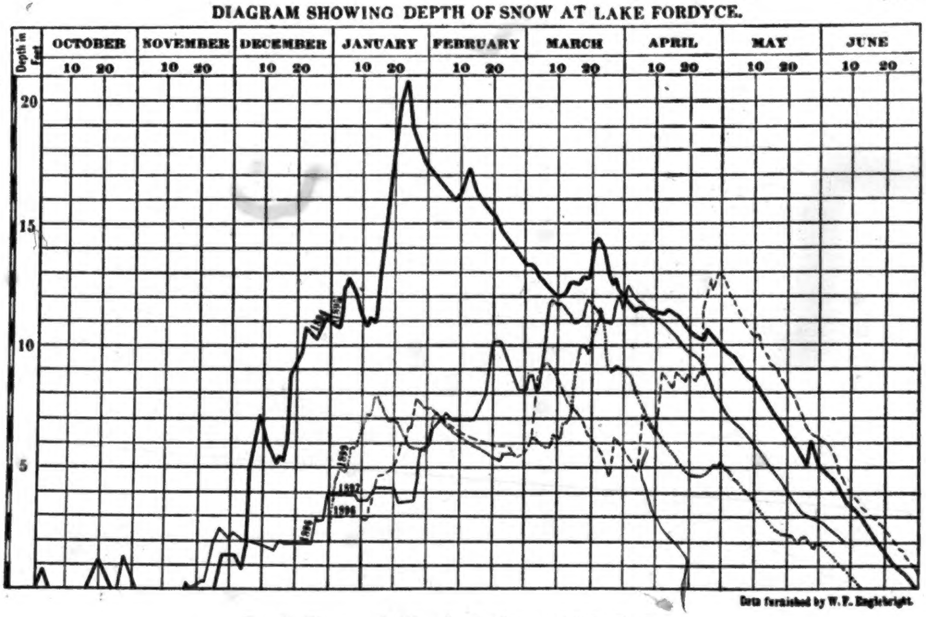
[1] These figures and the isohyetal lines on the general map are taken from a map prepared under the writer's direction for the California Water and Forest Association, showing the drainage area, mean annual rainfall, and forest distribution throughout the State.

By means of daily reports by telephone the chief engineer of the company is enabled through diagrams upon a larger scale to approximate during the latter half of April to within a few days of the duration of the snow supply and the beginning of the draft on reservoirs.

Data and studies of this kind are highly valuable and suggest the importance of stations above the snow line as a means of determining the volume of snow storage available in different seasons and the ratio between the volumes stored by snow and by reservoirs. The discharge of the streams is maintained during the spring and for one-half the summer months by snow, and the measure and rate of this discharge can be reasonably foretold by daily readings of properly situated gages.



Data furnished by W. F. Englebright.

Fig. 2.—Diagram showing depth of snow at Lake Fordyce.

ARTIFICIAL STORAGE FACILITIES ON YUBA RIVER.

SOUTH FORK.

The natural facilities for the storage of storm waters are particularly favorable in the upper third of the drainage basin of the South Fork. The demands for large volumes of water under high pressure to operate mines in the middle and lower portions of its drainage basin and those on Bear and American rivers were met by the construction of large and expensive canals and storage reservoirs.

Just above the great bend north of the head of Bear River and at the head of the steep canyon of the South Fork, there occurs a broad and flat glacial valley which has been converted into Lake Spaulding by a stone dam. The lake has a capacity of 270,000,000 cubic feet and is the lower and controlling reservoir of a series embracing the available storage supply above. This supply is derived from about 120 square miles upon which the mean annual precipitation in rain and melted snow is about 5 feet. Storage is had in the following reservoirs:

Reservoirs on South Fork of Yuba River.

Name of reservoir.	Elevation.	Area.	Capacity.	Cost of dam.
	Feet.	*Acres.*	*Gallons.*	
Meadow	7,515	300	1,275,000,000	$75,000
Stirling	7,200	100	340,000,000	20,000
White Rock	7,000	80	225,000,000	5,000
Peak Lakes (3)	6,900	150	1,275,000,000	(*a*)
Fordyce	6,500	474	5,950,000,000	300,000
Lost River	7,000	(*a*)	85,000,000	(*a*)
Fall Creek Lakes (6)	7,000	171	1,020,000,000	(*a*)
Spaulding	4,846	215	2,125,000,000	50,000
Summit Lake	6,800	400	1,938,816,000	30,000
Bear Valley Reservoir	4,400	60	145,411,200	8,000
Total		1,950	14,409,227,200	488,000

a Records lost.

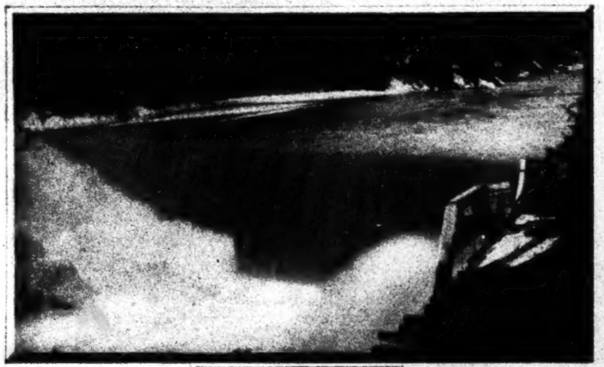
The aggregate area of these reservoirs is 3.05 square miles, which is filled to an average depth of 22½ feet, thus giving storage for about 12 per cent of the mean annual precipitation upon the tributary area, the remainder going to waste and to swell the floods which devastate the valley. It is possible, by raising the dams and enlarging the canals, to utilize another considerable fraction. The conditions favoring the conservation of water on the upper one-third of the drainage basin of the South Fork are far more favorable than in the lower two-thirds, or than those on the other forks.

Upon the upper portion of Canyon Creek, a tributary of the South Yuba, the Eureka Lake and Yuba Canal Company and the North Bloomfield Gravel and Mining Company have a system of storage reservoirs as follows:

Reservoirs on Canyon Creek.

Name.	Area.	Dam.			Elevation.*a*	Catchment area.	Capacity.
		Height.	Top length.	Cost.			
	Acres.	*Feet.*	*Feet.*		*Feet.*	*Acres.*	*Cubic feet.*
Bowman	500	100	425	$151,521	5,450	12,093	930,000,000
Sawmill Flat	80.6	39.2			5,780		2,000,000
Shotgun Lake	26.2	10			6,410		3,423,816
Island Lake	48.8	12.8			6,690		23,027,558
Middle Lake	11.2	12			6,460		2,395,800
Crooked Lake	10.3	3			6,510		1,600,000
Round Lake	8.1	11			6,590		2,906,630
Fall Creek					6,690		
Jackson Lake	20	5		246,000	5,410		15,000,000
Faucherie Lake	90	21	550	8,000	6,060	3,262	58,000,000
Weaver Lake	83.5	21.8					150,000,000
Eureka Lake	337.3	68.2	250	35,000	6,480	3,170	661,000,000
Total							1,849,354,804

a Barometric.



BAY CO. POWER CO'S DAM.

HEAD TUNNEL ALABAMA BAR.

ENGLISH RESERVOIR DAM.

IRRIGATION WORKS UPPER UBA RIVER. CALIFORNIA.

LAKE BOWMAN DAM.

THE BROWN'S VALLEY DAM.

BOWMAN LAKE OVERFLOW DAM.

The drainage area tributary to these reservoirs is 28.4 square miles, which receives a total precipitation during an average year of 4,589,481,600 cubic feet, of which 1,849,354,804 cubic feet is stored, or between one-third and one-half the mean annual precipitation.

MIDDLE YUBA.

On the Middle Yuba there are no reservoirs storing water at the present time. The only site of any importance is the Ruyard or English Reservoir which has not been in use since June, 1883, at which date the dam failed. It has a capacity of 650,000,000 cubic feet.

Weaver Lake is on the watershed of the Middle Yuba, but its catchment area is not large enough to fill it, so it is supplied from the Eureka Lake Company's Ditch from Canyon Creek, a tributary of the South Yuba, and is included in the previous list. At Milton there is an old reservoir site with an estimated capacity of 28,000,000 cubic feet. The total storage on the Middle Yuba may be considered 678,000,000 cubic feet.

NORTH YUBA.

On the North Yuba there are the following small lakes:

Lakes on North Yuba River.

	Acres.
Upper Sardine	38
Lower Sardine	40
Young American	9
Volcano	2½
Packer	7
Saxonia	2½
Deer	5
Upper Salmon	30
Lower Salmon	50
Hawley	11
Spencer lakes (2)	16
Sundry small lakes (5 not named)	27
Deadmans	3
Total	241

These might be developed to an aggregate storage capacity of 500,000,000 cubic feet.

Assuming that artificial storage on the North and Middle forks could be developed to a capacity equal to that above Lake Spaulding Dam, there would then be in service an area of 6.8 square miles at an average depth of 26.4 feet, or 5,692,000,000 cubic feet.

The mean annual precipitation upon the drainage basin of Yuba River is 170,829,000,000 cubic feet. The total ultimate artificial storage is less than 3.3 per cent of this precipitation and could hardly be recognized in a gaging of the total run off.

The losses from the surfaces of reservoirs from evaporation have been measured at Lake Fordyce. This may be considered typical for all the reservoirs. The measurements were as follows:

Evaporation at Lake Fordyce.

[Furnished by Mr. W. F. Englebright, chief engineer South Yuba Water Company. Elevation, 6,500 feet.]

Date.	Temperature.	Evaporation.	Date.	Temperature.	Evaporation.
	° *F.*	*Inches.*		° *F.*	*Inches.*
Aug. 10, 1900	64	$\frac{3}{16}$	Aug. 22, 1900	68	$\frac{3}{16}$
Aug. 11, 1900	65	$\frac{3}{16}$	Aug. 23, 1900	65	$\frac{3}{16}$
Aug. 12, 1900	65	$\frac{3}{16}$	Aug. 24, 1900	67	$\frac{3}{16}$
Aug. 13, 1900	64	$\frac{3}{16}$	Aug. 25, 1900	72	$\frac{3}{16}$
Aug. 14, 1900	65	$\frac{3}{16}$	Aug. 26, 1900	72	$\frac{3}{16}$
Aug. 15, 1900	64	$\frac{3}{16}$	Aug. 27, 1900	55	$\frac{1}{8}$
Aug. 16, 1900	64	$\frac{3}{16}$	Aug. 28, 1900	60	$\frac{1}{8}$
Aug. 17, 1900	63	$\frac{1}{8}$	Aug. 29, 1900	60	$\frac{1}{8}$
Aug. 18, 1900	62	$\frac{1}{8}$	Aug. 30, 1900	61	$\frac{1}{8}$
Aug. 19, 1900	64	$\frac{3}{16}$	Aug. 31, 1900	64	$\frac{3}{16}$
Aug. 20, 1900	64	$\frac{1}{8}$	Total for 22 days		$3\frac{5}{8}$
Aug. 21, 1900	60	$\frac{1}{8}$			

Average, one-sixth of an inch per day, and would probably average this for one hundred and twenty days each year, or 20 inches.

In the storage of water for industrial purposes the uncertainty of the character of the seasonal rainfall makes it prudent and desirable to permit the reservoirs to fill during the earlier rains, and not leave the possibility of husbanding a supply to the uncertainty of succeeding rains. Hence it generally happens that when the heavy storms of the late winter and spring months occur these storms find the reservoirs full and the flood wave passes down without being diminished by the capacities of the reservoirs. This is true to a limited extent of reservoirs above the snow line, for in these cases the snow constitutes a reservoir of far greater capacity than is ordinarily obtained behind dams. It also happens that in late warm rains or rapid melting of snows that reservoirs are already full, and that the reservoir capacity does not diminish the flood volumes.

It would appear, therefore, that however useful artificial reservoirs are for domestic and industrial purposes they can not be relied upon, except under exceptional circumstances, to decrease the height of late winter and spring floods.

FOREST STORAGE.

On the South Fork of the North Fork we have a watershed area of 139 square miles which was gaged on September 19, 1900, after three successive seasons of deficient rainfall, and gave a minimum run off of 113 cubic feet per second, or 0.8 cubic foot per second per square mile. This area is well covered with timber and brush, and in one hundred and twenty days gives a minimum run off of 1,441,152,000 cubic feet. The drainage basin of the North Fork is more heavily timbered than the basin of the other forks, and consequently has a deeper soil, and although only one-tenth the total drainage area it furnishes 75 per cent of the low-water flow of the entire drainage basin above Parks Bar.

On the South Fork, above Lake Spaulding, there is a watershed of 120 square miles which has heretofore been described as comparatively bare of timber, and the timbered areas which once existed have been cut off. The run off of this area is practically nothing for one hundred and twenty days each year, due to this absence of forests and brush. If this area were afforested and gave a minimum run off of 0.8 cubic foot per second per square mile, the discharge would be 100 cubic feet per second, or equivalent to 1,036,800,000 cubic feet effective storage capacity, a discharge more than equivalent to one-half the storage capacities of all the reservoirs above Lake Spaulding Dam. These aggregate 1,375,000,000 cubic feet, and the low-water discharge of 100 cubic feet per second for one hundred and twenty days is equivalent to a storage capacity of 1,036,000,000 cubic feet. As the basis of the above estimate is the extreme low-water discharge, it is safe to assume that by afforesting the watershed this costly and extensive system of reservoirs might be safely drawn upon for double their present capacity. When this reasoning is applied to the entire 1,357 square miles, instead of to small fractions thereof, the force of the argument becomes more apparent.

It would appear from the foregoing that the solution of the problem of storage of flood waters is not in the retention of a small percentage of the storm waters behind dams, but in applying storage over the entire watershed by the systematic protection and extension of forest and brush covered areas.

DEVELOPMENT OF POWER ON YUBA RIVER.

Nearly all the ditches and reservoirs in the basin of Yuba River were constructed to furnish water for mining purposes. Upon the rendering of the judgments in the cases of Woodruff *v.* the North Bloomfield Mining Company (18 Fed., 753) and the United States *v.* North Bloomfield Mining Company, circuit court of appeals (81 Fed., 243), hydraulic mining was suspended. It has been partially resumed under the "Camanetti act," passed March 1, 1893, which prescribes that where approved storage of detritus can be secured the operations may proceed under a permit granted by a commission composed of officers of the Corps of Engineers, U. S. A., and revocable by said commission should the restraining works prove inefficient.

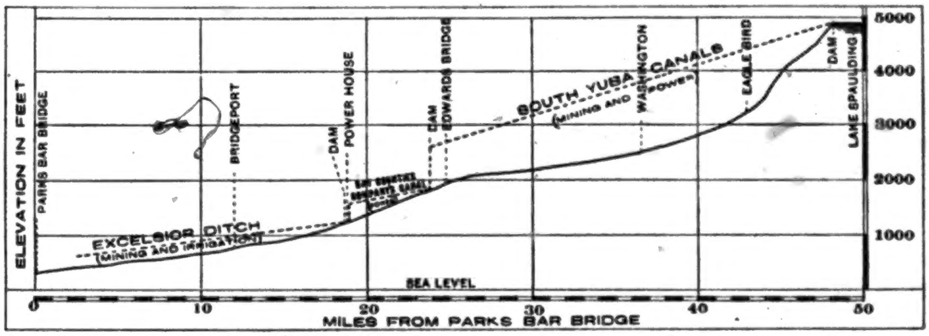

ELEVATION IN FEET
PARKS BAR BRIDGE
BRIDGEPORT
DAM
POWER HOUSE
DAM
EDWARDS BRIDGE
WASHINGTON
EAGLE BIRD
DAM
LAKE SPAULDING
EXCELSIOR DITCH
(MINING AND IRRIGATION)
SOUTH YUBA CANALS
(MINING AND POWER)
SEA LEVEL
5000
4000
3000
2000
1000
0
10
20
30
40
50
MILES FROM PARKS BAR BRIDGE

FIG. 3.—Diagram showing successive use of the water of Yuba River.

These restrictions have left a large surplus of water for which use has been sought in the development of electric power. There is at present more power developed in the Yuba River Basin than upon any other river in California. Some idea may be obtained of the magnitude of these works when it is understood that there are about 1,000 miles of ditches which cost, including reservoirs and dams, at least $6,500,000, in addition to which are the power stations, lines, etc., mentioned elsewhere in this report. An interesting feature in the development of water is its successive use. A diagram (fig. 3) is herewith presented which shows in general the mode. Water from Lake Spaulding and Lake Bowman systems is first used for mining; it is then picked up by the Nevada division of the Bay Counties Power Company and used for power, and immediately falls into the head of the Excelsior Ditch and is used for mining and irrigation at and below Smartsville, falling in this distance from 4,846 feet at Lake Spaulding or 5,450 feet at Lake Bowman to 200 feet above tide around Smartsville.

In the diversion of water into and from its own drainage basin Yuba River presents both cases. Water from the South Fork of Feather River is diverted across the divide between it and Yuba River at Woodville, at an elevation of 3,200 feet above tide, and is used in and around Challenge and by the Consolidated York Mining Company. Yuba River water from the South Yuba Water Company's system is diverted into the basin of Bear River, thence into the basin of American River, and some, via the New Blue Point Mining Company's Ditch, back into the basin of Yuba River.

OPINIONS UPON POINTS SUBMITTED IN CIRCULAR LETTER.

The conditions and circumstances attending the establishment of water rights in Yuba River Basin vary materially from those connected with the water rights acquired later for irrigation. Hence the same adjudications can not be applied to both.

In the circular of instructions sent to those in charge of the investigation reported in this bulletin there were several heads under which it was desired that they should express an opinion. The opinions expressed below by the writer on seven of these points are not in all cases specifically applicable to Yuba River, but are based upon a general acquaintance with the conditions throughout the State.

(1) The foundation of any system of administrative laws is the method of establishing rights to the stream. In your discussion of the results in California the first question to be considered is whether or not the present method of filing and recording claims to water is satisfactory. If not, what should take its place?

The present method of recording claims is not satisfactory, as the record can be made part of a claim to that which does not exist, namely, a surplus of water, laying the basis in some instances for vexatious suits at law.

The existence of a surplus of water should be determined by some competent State authority and the claim should be recorded in both the county and a central State office.

(2) Is the present method of adjudicating rights satisfactory? If not, what should replace it?

The present method of adjudicating rights is not satisfactory. The laws are contradictory, and have been evolved on opposing lines, and rest on no rational nor philosophical basis. A better system must be the product of gradual corrections of existing evils and the prevention of future conflict by the introduction of system and control.

(3) What has been the influence of the doctrine of riparian rights on the success of irrigation, and what modifications of this doctrine are suggested?

Riparian rights have prevented and retarded irrigation development. When riparian rights were adopted with the common law irrigation was not considered. If possible, the riparian right should be restricted to low-water discharge of streams, and this discharge determined by proper authority. Storm, or extra seasonal waters, should be subject to appropriation and storage, or all excess over low-water discharge be subject to appropriation for domestic or industrial use.

(4) Is the present system of stream control, or lack of it, and of dividing water between the different ditches which divert the common supply satisfactory? If not, what form of administration or control should take its place?

All waters in excess of low-water discharge should be declared the property of the State and made subject to appropriation under State control and supervision. Streams should be gaged and the volume of low-water discharge determined. Existing rights should then be determined and adjudicated, and future appropriations regulated according to the supply available.

(5) Should there be a State engineer, and what should be his duties?

This State has had an unfortunate experience in this matter. A broad and general law was drawn in 1878, which, by reason of antagonistic rights and unfortunate attempts to execute certain public works, grew into general disrepute. No State in the Union can be more benefited than California by a wise and unselfish administration and control of its water supply. An attempt to re-create the office of State engineer would be strongly opposed. There should be a department of public works, at the head of which should be three competent and experienced civil engineers of high standing.

This department should consolidate the work of river and swamp-land improvements, drainage and irrigation, highways and public buildings; and, upon a proper basis, would save expenditures now made upon these lines. The first members should be appointed for one, two, and four years, respectively, and thereafter for four years.

There has been expended over $20,000,000 on river improvement and swamp-land protection, much of which has been expended without system and without engineering supervision. Hence, no adequate returns have been had.

The outstanding bonded indebtedness of irrigation districts is over $16,000,000. The returns are far from being satisfactory. The annual expenditures upon highways are about $2,000,000, most of which is injudiciously and wastefully expended. The expenditures of these vast sums would have been more remunerative if systematically directed by a properly constituted department of public works.

The expenditures mentioned above, which aggregate $38,000,000,[1] will necessarily be duplicated during coming years as the interests extend and develop. The question now confronting this State is, Shall these expenditures be directed along well-considered and systematic lines, or shall they be expended as in the past and be as productive of inadequate results, delays, and litigation?

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[1] Includes only one year's expenditures on highways. See Report Bureau of Highways, 1897, and Department of Highways, 1899.

(6) Should there be a central office of record of claims or titles to water in place of the present separate county records, and what supervision or control should be exercised over rights to be acquired hereafter.

This question is answered with the first.

(7) What steps should be taken to secure the fullest conservation and use of water which now runs to waste? The discussion of this question to include State or national control and aid, the legislation needed to define rights to stored water, and to determine who is entitled to the water thus stored.

(1) The checking of the rate of run off by forest protection and extension through Government, State, and county aid.

(2) The withdrawal from sale or settlement of all forest lands, or mountain lands capable of being afforested, and the sale of timber under proper control, and the devotion of the funds thus realized to forest protection and extension.

(3) The repeal of laws which permit of the exchange of deforested lands for other lands of the public domain.

(4) The restoration to the public domain of all forest lands the title to which rests on fraud, perjury, or subornation of perjury.

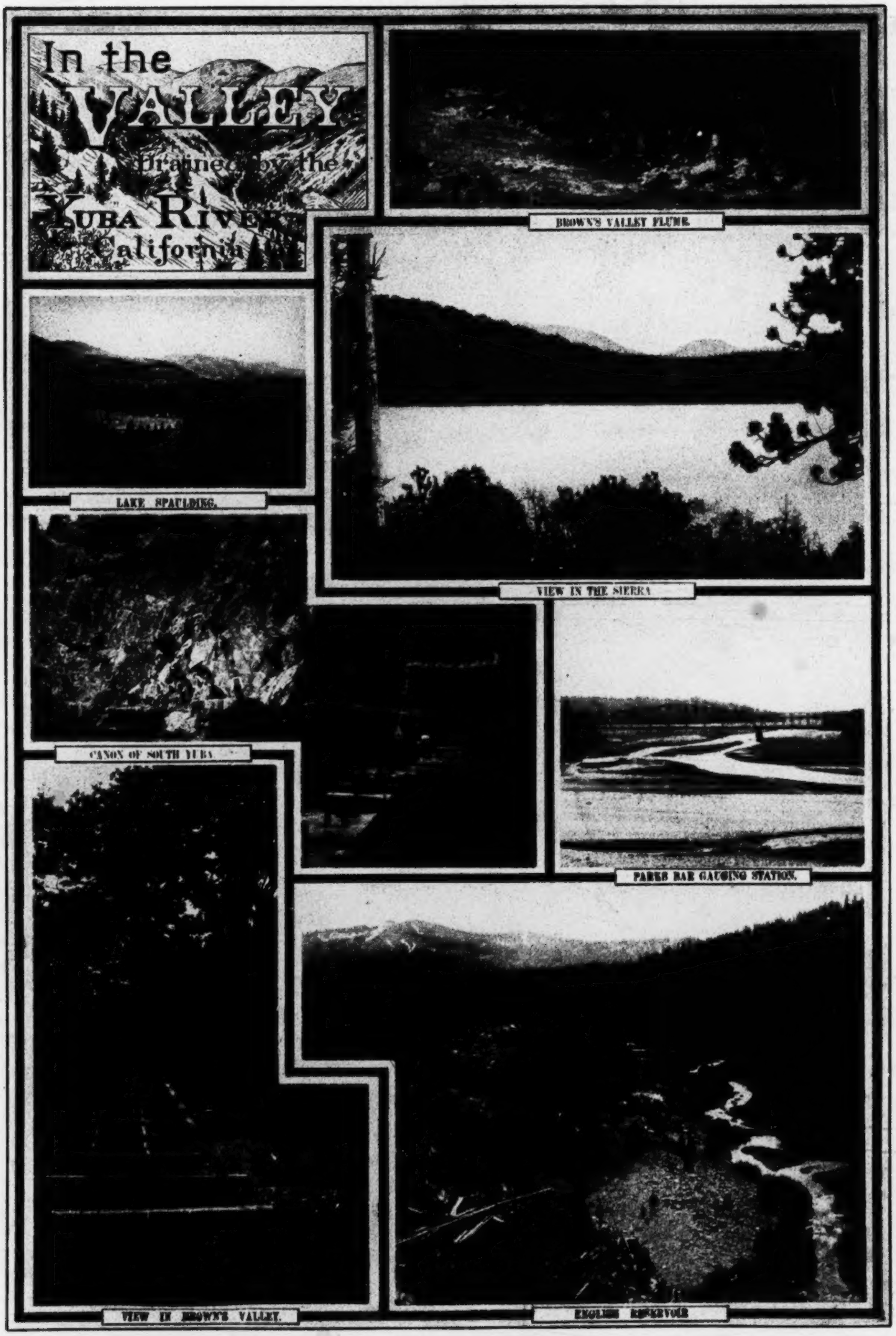
(5) The appropriation of a revolving fund of several million dollars, fractions of which can be used in those States which make an equal sum available for the construction of storage reservoirs. The waters of and rights to these reservoirs to be sold to land owners or cities and towns, and this fund returned to the revolving fund for the construction of other reservoirs in the same State. The construction and disposal to be under joint Government and State control.

APPENDIX.

THE USE OF THE WATER OF YUBA RIVER.

By H. D. H. Connick.

The irrigated lands in the Yuba River drainage basin are principally in the Browns Valley irrigation district and near Smartsville. Irrigation elsewhere is confined to small gardens and orchards of a few acres in and adjacent to the villages, such as Sierraville, Downieville, Camptonville, North San Juan, Woodville, Graniteville, North Bloomfield, Washington, French Corral, Columbia Hill, Cherokee, Sweetland, Birchville, etc. Operations here are, however, insignificant when compared with the irrigation practiced with water from Yuba River in the drainage basin of Bear and American rivers. There by far the greater portion of the Yuba River water used for irrigation is used in the fruit districts around Auburn, Newcastle, and Penryn, between Dutch Flat and Roseville.


In the
VALLEY
Drained by the
YUBA RIVER
California

BROWN'S VALLEY FLUME.

LAKE SPAULDING.

VIEW IN THE SIERRA.

CANON OF SOUTH YUBA.

PARKS BAR GAUGING STATION.

VIEW IN BROWN'S VALLEY.

ENGLISH RESERVOIR.

BROWNS VALLEY IRRIGATION DISTRICT.

Browns Valley irrigation district is located in Yuba County, Cal., in the lower foothills of the Sierra Nevada Mountains, at an average altitude of 300 feet above the sea. It comprises about 44,500 acres, and was organized September 19, 1888, under the Wright irrigation law.

On October 27, 1888, an election was held for the purpose of voting on an issue of bonds to the amount of $110,000, which resulted in favor of the bond issue. In March, 1892, a second election was held to vote on the question of issuing additional bonds to the amount of $30,000, which was also carried. Both issues of bonds sold for 90 per cent, or a total of $126,000. On August 27, 1893, an election was held to decide whether a special tax of $10,000 was to be levied on the district. One hundred and ten votes were cast, 73 being in favor of the special tax.

In November, 1899, construction was commenced on the main ditch and the principal branches. They were completed in 1893, and cost about $175,000. The main ditch is 48 miles long, the first 7 miles being flume, and 2 miles of the balance being short flumes. It takes its water from the North Fork about 2.5 miles above the junction of the North and Middle Yuba. The original crib dam was about 28 feet high and 168 feet on the crest. This dam has since been raised, it being at present 37 feet high and 168 feet on the crest. The water was turned into a flume, which carried it down the north bank of the river to Colgate. This flume was 4 by 5 feet, with a uniform grade of 9.6 feet per mile, and is claimed to have had a capacity of 3,000 miner's inches. From the end of the flume the water was carried to the Campbell Divide in a ditch 7 feet on top, 5 feet on the bottom, and 3 feet deep; grade, 9.6 feet to the mile, with a capacity of 3,500 miner's inches. From the Campbell Divide it was carried to the vicinity of Browns Valley in a ditch 7 feet wide on top, 5 feet on the bottom, 2.5 feet deep, upon the same grade. Besides this main ditch there are five principal branches which distribute water to the different parts of the district. The capacity of the system was limited to about 2,200 miner's inches. The main ditch was gaged on the west side of Dry Creek August 15, 1900. It contained 750 miner's inches. It would not carry more than 2,000 miner's inches at the present time.

Between the Campbell Divide and Dry Creek there is a drop of 296 feet, which is used to develop power by the Bay Counties Power Company.

During September, 1890, the district purchased from the Forbestown Ditch Company 29 miles of ditch, with a crib dam 12 feet high and 50 feet long in Dry Creek, and about 1 mile northwest from the Oregon House. Of the 29 miles of ditch 10 miles have been allowed to get out of repair. Twelve miles of ditch from the Finamore Ranch have been enlarged to 7 feet wide on top, 5 feet on the bottom, and 2.5 feet deep, and made part of the main line, and 7 miles comprise what is now known as the Sicard Flat Ditch. The price given was $7,700 in bonds worth 90 per cent.

In August, 1896, the district leased to Frank Page for fifty years the use of all the water which the district claimed (10,000 inches) for mechanical purposes, not inconsistent with the Wright irrigation law and its amendments, and not to interfere with the irrigation uses of said water. In return for these privileges said Page agreed to pay the Browns Valley Irrigation District $100 a year in two equal payments and keep the main ditch in repair and filled to its original capacity. Page repaired the main ditch, spending about $12,000 on it, but he did nothing to develop power. In October, 1897, he transferred the lease to John Martin, who built a small power house. John Martin transferred it to the Yuba Power Company on October 29, 1897. February 4, 1899, the Yuba Power Company transferred it to the Yuba Electric Power Company. The Yuba Electric Power Company, on May 25, 1900, transferred it to Andrew S. Morally; Andrew S. Morally on June 8, 1900, to Bay Counties Power Company, which holds it at present.

By reason of the scarcity of water this year, due to the reconstruction and enlargement of the flume below the headworks and the serious litigation now pending, actual irrigation is almost at a standstill. Of the 44,500 acres in the district, 10,500 are above existing distributing ditches. Of that portion below these ditches, the irrigable area is from 5,000 to 8,000 acres, of which only about 600 acres are actually irrigated, as outlined on the map of this district, which accompanies this report.

PRACTICE OF IRRIGATION.

DUTY OF WATER.

It is not possible to determine the duty of water with any degree of accuracy in the district, by reason of the inaccurate methods of measuring water. J. H. Perkins, in the town of Browns Valley, successfully irrigates 4 acres in clover and grass, and one-half acre in addition, covered with an orchard, with 7 inches of water used once a week for twenty-four hours. This is equivalent to the continuous use of 1 inch. This land has a slope of about 4 feet to 100, and no water runs to waste. The crops are as large as any in the valley, if not the largest. The opinion of most of the people of the district is that 1 inch to the acre, running continuously during the irrigating season, should be used on large tracts of grass and alfalfa. For orchards, about 1 inch to 3 or 4 acres is considered necessary. The duty of water in this district will always be low, because of the shallow soil and rapid evaporation, due to high temperature and dry atmosphere.

Alfalfa is the principal crop irrigated, there being about 300 acres of alfalfa under irrigation at the present time. Besides alfalfa the other crops irrigated are citrus and deciduous fruits, garden truck, and corn.

IRRIGATION OF ALFALFA.

There seems to be some difference of opinion in regard to the best time to sow alfalfa. Some claim if it can be got in and up to a height sufficient to resist the winter frosts, that late fall or early winter is the best time to sow, thus taking advantage of winter rains. Others think that early in April or May is the proper time. Many sow the alfalfa with grain, using the grain for a shade to the tender alfalfa.

The first crop reaches maturity in three or four months, and is generally light. From three to four weeks are required for the second crop and from six to seven for the third. Four crops could be cut, but the fourth crop could not be cured on account of the winter weather; so the field is generally pastured or cut and fed green.

The crops are generally about two tons to the acre cured, or six tons to the acre per year. The alfalfa has to be renewed about every six years, due to the growth of water grass and weeds, the seeds of which are introduced in the irrigation water.

Alfalfa is irrigated by flooding—that is, ditches are led along the highest parts of the field, from which water runs down in thin sheets over the adjoining surface. The winter rains are sufficient to produce one good crop of alfalfa, but in order to get more than one crop it must be thoroughly irrigated every ten or twelve days during the dry season. The first crop generally requires two irrigations, the second crop three, the third crop four, and the pasture crop two or three, making a total for the year of eleven or twelve irrigations. It may require a few more, or less, depending on the character of the season, slope, and depth of soil, etc.

Cost of raising alfalfa per acre.

Preparing land, plowing, harrowing, cross harrowing, and making ditches	$5.00
Seed, 25 pounds at 8 cents	2.00
Sowing, harrowing and brushing in	.50
Labor of irrigating (11 irrigations)	2.00
Water at the rate of 1 inch to 3 acres, at $2.50 per inch	.83
Total	10.33

To this is to be added the cost of harvesting the crop. Alfalfa is generally worth $5 a ton in Browns Valley.

IRRIGATION OF ORCHARDS.

The following fruits do well: Peaches, apricots, plums, prunes, oranges, figs, pears, almonds, and olives. All of these would yield better if more skill and care were taken in cultivation and irrigation. The orchards are generally very poorly kept. They are cultivated once a year and nothing more is done till the following year. In many of the orchards the grass and weeds are 2 feet high.

The method of applying the water that is most generally used is as follows: A ditch is dug along each row of trees and the water allowed to run along the ditch; most of the water runs through the ditch and finds its way into the nearest creek, carrying a small percentage of the soil with it.

Another and better method which was observed in use in a few orchards was to plow the ground so the furrows would be parallel. The ditches were dug along the ridges and in some instances were dug along each row of trees. From the ditches the water was turned into the furrows, and by this method the ground was given a good wetting.

Most trees require to be irrigated every three or four weeks, oranges every twelve or fourteen days. Irrigation of orchards generally commences in early June and lasts until the fruit is gathered or the first rain comes.

IRRIGATION OF HAY AND GRAIN.

Hay and grain are not usually irrigated in this district, although the opinion seems to be that it would pay to do so. In those instances where grain has been irrigated two or three times during the season the crops have been better than those on unirrigated land. There are about 4,000 acres of volunteer hay and grain which is cut for hay in the district. An average crop is 1 ton to the acre.

IRRIGATION OF CORN AND STRAWBERRIES.

Corn and strawberries do well. The furrow system of irrigation is used, and they are irrigated every ten or twelve days.

METHOD USED BY SAM SING COMPANY.

The following method is in use by some Chinamen for irrigating vegetables, such as sweet potatoes, etc.:

The vegetables are planted in parallel rows. The ditches are made along the ridges, which run at right angle to the furrows. These are successively filled. This is continued until the whole garden is gone over; by that time the water in the first furrow has all soaked into the ground. Then, if necessary, they go over the whole garden again. This method is very thorough and no water is wasted.

LOSS BY SEEPAGE AND EVAPORATION.

Because of the character of the soil and the location of the main or lateral ditches, there is very little loss by seepage. Most of the flumes have been lately replaced, and leakage is reduced to a minimum. Owing to the carelessness in the construction of the distributing ditches the loss by seepage is considerable, the ground being wet on both the upper and lower sides for some distance.

There is no data in regard to the loss of water from these ditches due to evaporation, but it must be considerable, especially in smaller ditches, owing to the extreme heat of the summer.

LOSS BY UNSKILLFUL IRRIGATION AND INSUFFICIENT PREPARATION OF LAND.

Evidences of the losses due to unskillful irrigation are visible almost everywhere. All the creeks and ravines have running water in them through the summer, though before irrigation commences they are dry. When irrigation is in progress, waste water can be seen even in the roads. With the exception of that used by one or two farmers who utilize the water flowing in the ravines, it all runs to waste; most of them do not realize that surplus and waste water can be used the second time.

The waste from insufficient preparation of the ground is considerable. It is due to lack of experience, insufficient means, and the indifference begotten by prolonged litigation and clouded titles. The owners do not feel justified in making large expenditures on land that might be taken away from them at any time.

MEASUREMENT.

The standard of measurement is the miner's inch under a 6-inch head. The method of measurement is as follows: A box with a gate in it is set in the side of the ditch. When the ditch tender wishes to turn into a distribution ditch, say, 4 miner's inches of water, if the water in the main ditch is about 7 inches above the bottom of the box, he raises the gate of the box (a 4-inch box) 1 inch. If the water is more than 7 inches above the bottom of the box, he shuts down the gate till he thinks he has about 4 miner's inches running through. It is the intention to deliver the number of inches purchased at the ranch line. So if the water has to run some distance from the ditch, as it frequently does, the ditch tender guesses at the loss by evaporation and seepage and adds that amount to the amount purchased. If the farmer thinks he is not getting as much water as he is paying for, he goes to the ditch and helps himself to all he thinks he is entitled to. It is the custom along some of the ditches to open the gate so that the number of square inches in the opening is equal to the number of miner's inches purchased, the ditch tender claiming that the head averages about 6 inches, being below as often as it is above.

SEASON OF IRRIGATION.

There is only one season of irrigation. It commences in April or May and ends with the first rain. It may commence somewhat earlier or later, depending on the amount and lateness of the winter rains.

SOIL.

With the exception of the extreme western edge of the district, where there is more or less gravel, the soil is nearly all red clay, containing some adobe and overlying a cemented gravel called hardpan. This clay ranges from 1 to 5 feet deep, although in many places the bed rock appears on the surface. This bed rock is slate. The soil absorbs water slowly and dries out quickly, owing to its shallowness. To be worked successfully it has to be plowed at just the right degree of wetness, otherwise it will not pulverize. This is a strong inducement in favor of small ranches. On a large ranch there is a possibility that there will not be enough days in the year when the ground is in good condition to put in proper tilth for crops.

EFFECT OF IRRIGATION ON SOIL.

The water used in irrigating the district has all been previously used in mining, therefore it is always more or less charged with fine sand or sediment. From this fact the water is especially beneficial in irrigating shallow soil. It is the general opinion of the irrigators that muddy water is beneficial, except when applied to the stems of very young plants, or when alfalfa, etc., are flooded too deeply, leaving a sediment that stock do not like.

EFFECT ON HEALTH.

There seems to be no ill effect on the health of this community that can be traced to irrigation.

VALUE OF LAND.

It is impossible to determine the value of land in the vicinity. The district has been involved in litigation for some time, and the titles to all the land in the district have become involved. There has been no sale of land for several years. The opinion of the people of the various parts differs as to the value of the land. From $20 to $30 per acre seems to be the value placed on good land susceptible of irrigation and not under cultivation, where it is under the ditch and water can be got on it.

The same class of land above the ditch is worth from $5 to $7 per acre. If the conditions were such as to remove the doubts as to titles the price of land would rise.

It was the custom, before the district leased the mechanical privileges of its water, to allow the residents to do the work necessary to keep the system up. They were paid in water at the rate of $1.50 per day, the water being sold at $2.50 per miner's inch, running continuously through the season.

METHOD OF DISTRIBUTING THE WATER.

The method of using the water is different in different parts of the district. It seems to depend somewhat on the friendliness of the farmers to one another. Some buy as large a head as they desire to use, and it is kept running continuously whether used or wasted. In some parts of the district several farmers will combine their rights to water and use the entire head in turn, the length of time varying in proportion to each contributor's share. For instance, if the combined head was 24 inches and A furnished 4 inches and it was decided to irrigate every 12 days, A would have the use of 24 inches for two days in every twelve. The reason of this is that one can irrigate better and more economically with a large head than with a small one. A very few make some attempts at storing water.

The district owns no service reservoirs. There are a number of sites for such reservoirs, as yet undeveloped.

Distribution of water is arranged as follows: At any time a purchaser wants water he informs the secretary of the district, who orders the ditch tender to turn it on. The district charges a uniform price of $2.50 per inch per season, whether irrigation is started at the beginning of the season or not. But the district does not guarantee the delivery of the water.

There is no surplus water to be purchased by landowners outside of the district, but ordinarily, and particularly this year, there is a deficiency.

DUTY OF WATER AROUND AUBURN.

This region, although not embraced in the Yuba River watershed, is supplied therefrom, and it is deemed advisable to outline the practice and results there obtained.

W. J. McCann irrigates 40 acres, of which about one-half acre is in oranges, the balance deciduous fruits, planted 108 trees to the acre. He uses one miner's inch to every 10 acres. He says he is not using sufficient water, and could do better if he used about 1½ inches to 10 acres. His practice is to run a ditch midway between the rows of trees and one alongside of each row, with circles inclosing the trees.

Mrs. Robinson has under cultivation 60 acres, of which 50 acres are irrigated with 4 inches of water. She says that she has not water enough. Olives planted 80 trees to the acre are the principal crop, but peaches, pears, plums, and grapes are also raised. She does not run the ditches along the rows, but runs them on a very light grade and encircles each tree. The water is used in continuous rotation over the tract.

George Kellogg has 60 acres in his place, of which 56 acres are irrigated with 8 inches of water. The ranch is in deciduous fruits, 108 trees to the acre. He irrigates by making ditches from 20 to 24 inches from each row of trees. He divides his 8 inches of water so as to irrigate several rows at once, and lets it run until he thinks these rows have had enough; then he turns it upon another group, and so on until the whole orchard has been gone over.

Ed. Katzenstein has 80 acres, 35 to 40 of which he irrigates with 5 inches of water. The land is in deciduous fruits, 108 trees to the acre. Part of the trees are planted in parallel rows, and the ditch runs along above them. The rest are planted in squares, with the ditch on the upper side.

W. R. Fountain has 80 acres, of which 55 to 60 are irrigated with 5 inches of water. He thinks he requires 6 inches. The land is in deciduous fruit trees, planted 18 feet apart in squares. He irrigates by running a ditch along each row of trees, and encircles each tree. Nearly all of Mr. Fountain's land has a steep slope; so he turns a very small amount of water down each furrow and lets the water cut a deep ditch. By doing this he gets a high duty, as the water does not wet the top of the ground, but wets the ground near the roots, where the water is most needed, and reduces loss by evaporation.

Charles Carlson has 40 acres, which he irrigates with 6 inches of water. The whole is in trees, planted 134 to the acre, except 1 acre of grapes. He uses a ditch along each row of trees, with a half circle around each tree, and irrigates 40 rows at a time, changing the water every twenty-four hours. He gets over his 40 acres every three or four days. Part of the orchard is in early fruits and part in late fruits.

COST OF RAISING OLIVES AND PEACHES.

It may be interesting to add the cost of raising the two principal crops for which the country in the vicinity of Auburn is noted.

Cost of raising olives per acre.

FIRST YEAR.	
Plowing and cross plowing	$8.00
Harrowing and cross harrowing	3.00
Eighty holes, at 10 cents	8.00
Eighty trees, at 25 cents	20.00
Planting	8.00
Cultivation, twice, at $3	6.00
Making ditch	.50
Water, 1 inch to 10 acres	4.50
Labor of irrigation	1.50
	59.50
SECOND YEAR.	
Plowing and cross plowing	$8.00
Harrowing and cross harrowing	3.00
Cultivation	.50
Water, 1 inch to 10 acres	4.50
Labor of irrigation	1.50
	17.50

The orchard should be pruned every three to five years, at a cost of $10 per acre. The seventh year olives commence to bear, and reach full bearing at ten or eleven years.

Value of Produce.

The olive crop is either made into oil or pickled. In a fair year olives will pay about $200 per acre if made into oil. If the olives are pickled they will pay about $800, one acre producing about 1,600 gallons, which will bring 75 cents per gallon. The cost of pickling is about 21 cents, in addition to the cost of caring for the orchards and gathering.

Cost of Raising Peaches.

The cost depends on the locality of the orchard. The maximum and minimum cost of several estimates are given below:

Cost of raising peaches per acre.

Operation.	Cost.	
	Maximum	Minimum.
FIRST YEAR.		
Plowing and cross plowing	$4.00	$4.00
Harrowing and cross harrowing	2.00	1.00
Digging holes	[a]10.80	1.00
Trees	16.20	16.20
Planting and setting trees	3.00	2.00
Cultivation and cross cultivation	5.00	3.00
Water, at rate of $45 per miner's inch	6.00	4.50
Preparation of land for irrigation	8.00	2.50
Hand cultivation and pruning	.75	.50
Labor of irrigation	3.00	2.50
	58.75	37.20
SECOND YEAR.		
Plowing and harrowing	4.00	3.00
Water	6.00	4.50
Preparation of land for irrigation	.50	.50
Labor of irrigation	3.10	2.50
Pruning	3.00	.50
Spraying	2.50	.50
Cultivation	5.00	2.00
	24.10	13.50
THIRD YEAR.		
Plowing and harrowing	4.00	3.00
Water	6.00	4.50
Preparation of land for irrigation	.50	.50
Labor of irrigation	3.10	2.50
Pruning	2.50	1.00
Spraying	2.50	1.00
Cultivation	5.00	2.00
	23.60	14.50
FOURTH YEAR.		
Plowing and harrowing	4.00	3.00
Water	6.00	4.50
Preparation of ground	.50	.50
Labor of irrigation	3.10	2.50
Pruning	3.50	2.00
Spraying	2.50	2.00
Cultivation	5.00	2.00
	24.60	16.50

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[a] Soil very shallow; the holes have to be blasted in the bed rock.

The crop of the fourth year will produce enough to pay expenses, and it will increase to full bearing about the sixth or seventh year. An acre of prunes or peaches in a well-managed orchard ought to clear on an average $25 per acre per year.

PRINCIPAL DITCHES AND RESERVOIRS IN THE BASIN OF YUBA RIVER.

SOUTH YUBA WATER COMPANY.

The South Yuba Water Company was organized to furnish water for municipal supply, irrigation, mining, power, etc. Its range of operations is in parts of Placer and Nevada counties. The company is the result of the consolidation and absorption of a number of water and ditch companies which were organized subsequent to 1850 to furnish water to mines.

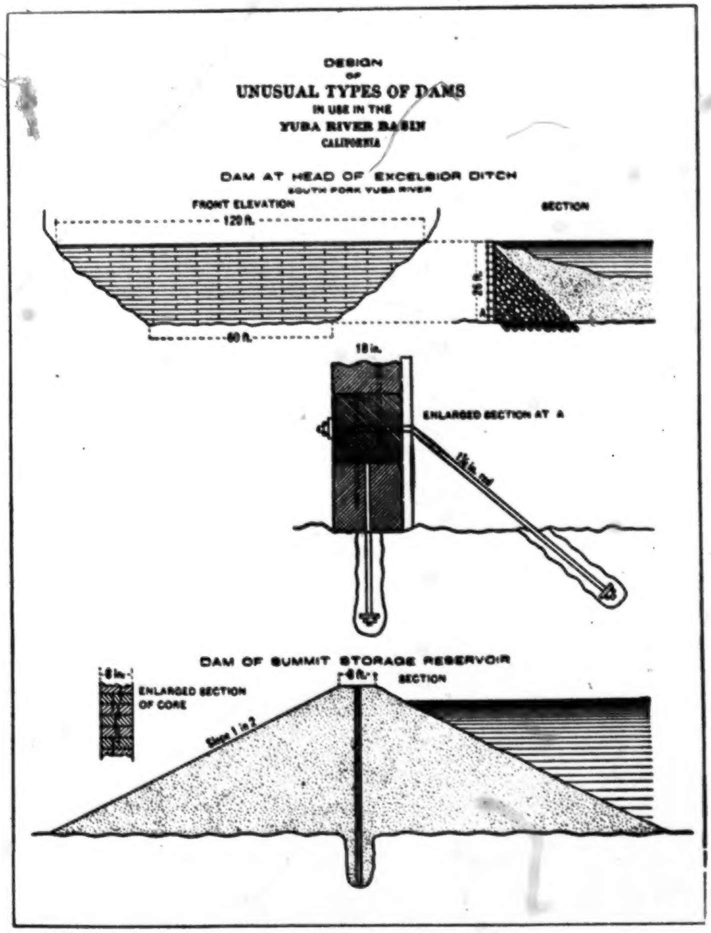
DESIGN
OF
UNUSUAL TYPES OF DAMS
IN USE IN THE
YUBA RIVER BASIN
CALIFORNIA
DAM AT HEAD OF EXCELSIOR DITCH
SOUTH FORK YUBA RIVER
FRONT ELEVATION
120 ft.
60 ft.
SECTION
20 ft.
A
18 in.
ENLARGED SECTION AT A
1½ in. rod
DAM OF SUMMIT STORAGE RESERVOIR
8 in.
ENLARGED SECTION OF CORE
6 ft.
SECTION
Slope 1 in 2

FIG. 4.—Unusual types of dams in Yuba River.

The drainage area supplying the works of this company is that of the South Fork of the Yuba River, elsewhere described in this report (p. 118). There are in this area 17 storage reservoirs.

The principal reservoir is Lake Fordyce, which has an extent of 474 acres. It is situated on the North Fork of the South Yuba, 16 miles above the head of the main canal and 6,500 feet above the sea. The dam, built in 1873, in a gorge at the outlet of the Fordyce Valley, was subsequently enlarged. It is now 85 feet long, 72 feet high on the inside, and 90 feet high on the outside, and 125 feet wide at the base. It is a dry-rock wall, lined on the inside with 3-inch plank, and has a wasteweir 100 feet long and 5 feet deep. It cost $300,000.

Two miles to the north of Lake Fordyce, at an elevation of 7,500 feet, is Meadow Lake, covering an area of 300 acres. The dam forming this reservoir is 1,100 feet long, 40 feet high, and 100 feet wide. Its cost was $75,000.

Stirling Reservoir is likewise situated above Lake Fordyce and empties into it. Its dam is a rock-filled crib, lined on the inside face with 3-inch plank. It is 200 feet long, 20 feet high, and cost $20,000.

Lake Spaulding forms at the lower end of this group of reservoirs a distributing reservoir for the entire watershed. This reservoir occupies a broad, deep valley, the lower end of which is a rocky, narrow gorge. In this, during 1891 and 1892, a dry-rock dam faced with plank was erected. The dam is 290 feet long, 67 feet high, and 67 feet wide; and the outlet is through a tunnel cut through granite. The dam is provided with two wasteweirs, each 120 feet long. The area of the reservoir is 215 acres, and the capacity over 2,000,000,000 gallons.

Bear Valley Reservoir was formed by building two dams across Bear River. One of these has a height of 35 feet and a length of 140 feet; the height of the other is 15 feet and its length 160 feet. The reservoir acts as a distributing reservoir for all the ditches in the Bear River watershed. Its area is 60 acres, and its capacity 145,411,200 gallons. It cost $8,000.

Summit Reservoir has just been finished. It is located in Summit Valley at an elevation of 6,800 feet, and is the highest of the company's reservoirs. It was formed by building a dam 1,580 feet long, with a maximum height of 35 feet. The construction of the dam is shown in fig. 4. The area of the reservoir is 400 acres, and its capacity 1,938,816,000 gallons. Its cost was $30,000.

THE SOUTH YUBA CANAL SYSTEM.

The main canal of this system heads in the canyons of the South Fork of Yuba River, three-fourths of a mile below Lake Spaulding. A small timber dam diverts the waters from the canyon through a short tunnel into the head of a 5 by 7 foot wooden flume, which is skillfully built or fastened to the precipitous granite wall of the canyon. This flume terminates in a canal which passes over the low divide at the head of Bear River, and thence in two main canals down the valley of Bear River. The northerly canal pierces the divide and leads back into the Yuba River drainage basin through a tunnel and distributes water to Nevada City, Grass Valley, and other places. The southerly canal supplies Colfax and Auburn and the divide between the Bear and American rivers. The cost of these main canals was $600,000. The locations are sketched on the map which accompanies this report.

The following table gives the names, lengths, and capacities of the distributing canals:

Distributing canals of the South Yuba Water Company.

Name of canal.	Length.	Daily capacity.	Name of canal.	Length.	Daily capacity.
	Miles.	*Gallons.*		*Miles.*	*Gallons.*
Main to Bear Valley	....	136,000,000	Auburn Town (2,000 feet 11-inch pipe)	0.875	1,700,000
Main, entire	16	102,000,000			
Dutch Flat	25	68,000,000	Shirlin	4	1,700,000
Chalk Bluff	14.5	34,000,000	Ophir	10	8,500,000
Cascade	8	34,000,000	Cook	4	1,750,000
Leonard	13.5	34,000,000	Gold Blossom	2	1,750,000
Pittsburg	1.5	8,500,000	Gold Hill	20	8,500,000
Deer Creek	6	8,000,000	Danetown	6	2,350,000
Snow Mountain	9	20,400,000	Whisky Diggins	7	850,000
Coyote	1.5	17,000,000	Sebastopol	8	1,275,000
Wet Hill	2	3,400,000	Lincoln	14	1,235,000
Cement Hill	4	3,400,000	Newcastle	5	10,200,000
Rock Creek	7	5,100,000	Frenchmans	4	1,700,000
Ridge	18	34,000,000	Banyard	8	2,550,000
Ridge	6	4,250,000	Antelope	10	6,880,000
Blue Tent	4	34,000,000	Caperton	10	2,550,000
Round Mountai	4	1,700,000	Penryn (1,200 feet of pipe)	3	1,700,000
Remington	10	8,500,000	Greeley (9,500 feet 11-inch pipe)	10	17,000,000
Fall Creek	11.5	17,000,000	Dutch Ravine	2	....
Auburn Main	58	34,000,000	Coyote	3	6,800,000
Iron Mine	6	17,000,000	Loomis (1 mile 11-inch pipe)	6	4,250,000
Atwood (10,000 feet 6-inch pipe)	3	850,000	Total	380.375	....
Fiddlers Green	15	8,500,000			

In addition to those listed, the company owns a number of old canals not now in use, which could be reopened if water were needed on their routes.

The water appropriated by the company is being used for various purposes. Nevada City, Grass Valley, Auburn, Newcastle, and Lincoln use the water for municipal supply. In Auburn and Newcastle the waterworks are owned by the company outright. In Lincoln the company owns a half interest. In Nevada City and Grass Valley local corporations own and operate the systems, purchasing from the South Yuba Company the necessary water.

To cover rights of way and protect water rights and reservoir sites, the company owns about 4,500 acres of land. It also owns and operates mining lands to the extent of 948.27 acres.

THE SALE OF WATER.

The standard of measurement is the miner's inch, which is the quantity of water that will flow through an aperture 1 inch square, the center of the aperture being 6 inches below the surface of the water, or, approximately, 17,000 gallons in twenty-four hours.

The rate at which water is sold for purposes of irrigation is $45 a year per miner's inch. As 1 inch will suffice for 7 acres of land, the annual expense to the farmer is less than $7 per acre. Water for power is sold in miner's inches, except in special cases where it is delivered with the horsepower as the unit of measurement, and all water so used is returned after use to the company's canals. The rate of sale is 18 cents a day per horsepower. The charge for water sold in bulk to municipalities is 18 cents and upward per inch, according to amount, cost of delivery, etc. Where waterworks are owned by the company the rates are collected from families on a gross charge for general family use, under liberal regulation charges. These average $2 per month per family.

VALUE OF THE PROPERTY.

Including the water rights and rights of way the entire property owned by the South Yuba Water Company is now valued at $4,000,000.

SUMMIT WATER AND IRRIGATION COMPANY.

The property of this company is situated on the ridge between the South and Middle forks of Yuba River. Its water rights represent the combined rights of several companies and are among the oldest in the Yuba River Basin. The works were constructed between 1851 and 1856. They were originally constructed to furnish water to the various miners along the ridge, but recently the company has acquired mining properties and the water is nearly all used upon these properties.

From Eureka to the summit of the Sierras the geological formation is principally granite. The slopes rise into high and rugged peaks, some of which attain an elevation of 8,500 feet. The Middle and South forks with their tributary streams, such as Canyon Creek, Pass Creek, and others, rise in these mountains, among which are numerous lakes from 20 to 400 acres in area. The Summit Water and Irrigation Company has formed a system of reservoirs by building dams at the outlets of many of these lakes.

Eureka or French Lake is situated at the head of Canyon Creek about 4 miles west of the summit, and is the principal reservoir of this system. A substantial dam formed of granite blocks was erected in 1858 and 1859, at a cost of $35,000. The width at bottom is 120 feet, height 70 feet, and length on top 250 feet. The front is protected with two layers of 25-inch lumber well secured to the face of the dam. An arched sluice is constructed through the dam, by which the flow of water is regulated. The high-water mark is 62.5 feet above the bottom of the outlet. The area is 337.2 acres and the capacity 661,000,000 cubic feet. Mr. George Black reported in 1864 that the height of the Eureka Dam could be safely raised 12 feet, or to a total height of 82 feet. This would increase the storage capacity of the dam 262,000,000 cubic feet. The catchment area of the lake is 5 square miles.

The waters of Eureka Lake flow down Canyon Creek 10 or 12 miles to Faucherie Lake, which is about 600 feet lower in elevation. Faucherie Lake is the basin of a natural lake, the surface of which was originally raised by a dam 44 feet high, forming a reservoir with an area of 139 acres, a catchment of 3,262 acres, and a capacity of 170,000,000 cubic feet. This dam was washed away and has been replaced by one 21 feet high, which forms a reservoir with an area of 90 acres, a capacity of 50,900,000 cubic feet, or about one-third the capacity of the reservoir as first constructed. The cost of this new dam was $8,000.

Weaver Lake is a natural lake situated about 2 miles north of Bowmans. Its catchment area is small, but as it is commanded by the Eureka Lake Ditch it can always be filled. Its level has been raised by a small dam 22 feet high, so that it now covers 83.5 acres and has a capacity of 150,000,000 cubic feet.

This company owns several other small lakes, including Jackson Lake, which have an estimated capacity of 75,000,000 cubic feet. The entire system of reservoirs places at their disposal 934,000,000 cubic feet of water, which, by raising the dams, could be increased to 1,376,900,000 cubic feet.

Weaver Lake was tapped by the Miners Ditch, which has a capacity of 700 inches. A large portion of this canal was composed of a wooden flume peculiarly supported by chains to the side of the canyon. That portion of the flume which was on the south bank of the Middle Yuba was washed out in 1883, at the time of the break of the English Dam, and it has not been replaced. The waters of Weaver Lake could be turned into the Middle Yuba and taken up by the San Juan Ditch, but the ditch is out of repair.

The principal canal of this system is the Eureka Lake Ditch, which cost $430,250. It takes water from Faucherie Lake and carries it down the divide to Columbia Hill. Its total length, including distributing ditches, is 54 miles. Its capacity is 2,500 miner's inches.

In 1876 the company had 154 miles of ditches, with a total capacity of 25,150 miner's inches. These ditches could supply only 8,800 inches during the wet season and 4,600 during the dry season. The cost of the ditches and reservoirs of the system is as follows:

Cost of Summit Irrigation Company's works.

Eureka Lake and flume	$256,000
Smaller ditches, water right, etc	174,250
Eureka Lake Dam	35,000
Faucherie Dam, original	8,000
Smaller dams	2,000
Other connecting ditches and water rights	68,000
Miners Ditch and reservoir	180,000
Distributing reservoir	50,000
Middle Yuba Canal or San Juan Ditch from river to Manzanita Hill	261,765
Manzanita Hill to Birch Hill	31,227
Distributing reservoir below San Juan	18,000
Total	1,084,242

It may be interesting to give some figures in regard to the cost of maintenance and sales of water under the system. The total cost of maintenance of these ditches for the eleven years, 1866–1876, was $936,433.48, and the average cost per year was $85,403. During these eleven years the company's sales of water amounted to $1,988,603.

The company first started to sell water to the various miners along the ridge, but later it acquired mining property of its own and used a large portion to work its own ground. Very little water is sold for irrigation, the annual returns not exceeding $200. There are no established rules in regard to its use and price. The water is used principally on the small farms and orchards in the vicinity of Moores Flat.

KATE HAYES COMPANY.

This company was originally known as the Milton Mining and Water Company. In 1890 it was disincorporated and was reincorporated as the Kate Hayes Company. The rights of this company are located near the headwaters of the Middle Yuba, where the company owns several valuable reservoirs. The principal one, about 13 miles east of Graniteville, is English Lake. This reservoir was formed between 1856 and 1858 by constructing three crib dams, which connected two granite knobs at the lower end of a glacial lake with higher lands on each side. In 1876–77 Hamilton Smith, jr., raised the height of the dams to 86.57 feet above the bottom of the gates. The back wall of the center dam had a height of 131 feet. The walls were of dry rubble, covering a solidly filled crib, and faced with plank on the upstream side. The cost was $155,000. At 81 feet above the gates the elevation is 6,605 feet above tide, area 363 acres, and capacity 650,000,000 cubic feet, and the catchment area is 12 square miles. The center dam failed in June, 1883, causing considerable damage below. It has never been rebuilt. The cause of the break has never been ascertained. The two end dams are at present in fair condition, with the exception of the facing and flash boards.

At Milton, on the Middle Yuba, there is another reservoir site. It, however, has never been developed. This reservoir has an approximate elevation of 5,800 feet, an area of 90 acres, and a capacity of 28,000,000 cubic feet. It could be utilized at a comparatively small cost. A main dam about 30 feet high, 250 long, would be required, besides an additional smaller dam 120 feet long. The reservoir has a catchment area of 30 square miles below the English Reservoir.

At Little Grass Valley there is another reservoir site which would have an area of 65 acres and capacity of 62,061,250 cubic feet at a depth of 70 feet. The reservoir has a very small catchment area, but could be used as a service reservoir in connection with Milton Ditch. It would require two dams, the largest of which would be 70 feet high and 600 feet long.

The principal canal of this company is the Kate Hayes, or Milton Ditch, which takes water from the Middle Yuba at Milton, where the company has a small diverting crib dam. The canal follows the main ridge between the Middle and South Yuba to French Coral. The ditch has a total length of 63 miles. It is 7.65 feet wide on top, 4 feet wide on the bottom, and 35 feet deep. The grade is from 16 to 32 feet to the mile. It was built in 1873–74 at a cost of $462,998, and its original capacity was 3,000 miner's inches.

Most of the water in the Kate Hayes Ditch is used at the Badger Hill Mine. About 200 inches are used at French Coral for irrigation and mining. The low-water discharge of the Middle Yuba is capable of supplying this ditch for only three or four months of the year. The balance of the time water is obtained from the reservoirs of the North Bloomfield Gravel and Mining Company.

The charges made by the company are 12.5 cents per inch for ten hours, and 20 cents per inch for 24 hours, for water used for irrigation. The farmers along the line of the ditch consider this rate prohibitive for ordinary crops, and consequently use the water only to irrigate gardens and orchards. During 1900 the owners decided not to maintain the lower end of its ditch, but, as this would leave the farmers in the vicinity of French Coral without water, that portion of the ditch between North San Juan and French Coral was turned over to Mr. Thomas, of Birchville, who agreed to keep up the ditch and deliver the water to the farmers. The company gave Mr. Thomas the 200 inches of water, and allowed him all he could make for keeping the ditch up. Mr. Thomas maintained the rates previously given.

Irrigation is very limited in this vicinity, there being in all about 500 acres watered from this ditch. The crops irrigated are alfalfa, fruits, and vegetables. The practice is to irrigate gardens every three or four days, alfalfa every twelve to thirteen days, and orchards every fourteen to sixteen days.

The duty of water will always be low, as the soil is a shallow red clay, and the temperature during the irrigation season is quite high. About 10 inches of water used every seven days during the season of sixteen weeks will irrigate 2 acres.

NORTH BLOOMFIELD GRAVEL AND MINING COMPANY.

The North Bloomfield Gravel and Mining Company was incorporated in 1866. Its water rights are located on the same watershed as those of the Summit Water and Irrigation Company, but lower down on Canyon Creek, and embrace the overflow from the Summit Water and Irrigation Company's reservoirs, together with an additional catchment area of 19 square miles. The principal reservoir is Bowmans Lake, which is situated about 6 miles east of Graniteville on Canyon Creek, a tributary of the South Fork. This reservoir was designed for the supply of water during the dry season to work the gravel mines which were owned by the company.

In ordinary seasons the Summit Water and Irrigation Company's reservoirs retain all the water flowing from the catchment area of Bowmans Lake, which has an extent of about 19 square miles. The mean annual rainfall at Bowmans is about 75 inches, of which 75 per cent is run off. Two dams are required to impound the water at Bowmans. The main one, placed across the narrow gorge forming the outlet of the valley, has a maximum height of 100 feet (96.25 feet above the datum base line) and an extreme length on top of 425 feet. The smaller dam, placed across a gap near the mouth of the valley, has a maximum height of 54 feet and an extreme length of 210 feet. It is fitted with wasteways, and over it is discharged the excess above the capacity of the reservoir. High-water mark is fixed at a point 1.5 feet below the crest of the main dam. At this height the reservoir, with a surface area of over 500 acres, contains 918,000,000 cubic feet of water. By placing flash boards on the top of the wasteway the water is raised to the 96-foot level (above datum base), increasing the capacity of the reservoir to 930,000,000 cubic feet. The stream feeding the reservoir has a maximum flow during great freshets of 5,000 to 7,000 cubic feet per second. The dams at Bowmans Lake have been designed to withstand not only freshets, but also any additional strain due to the breaking of the dams above. The main dam cost $15,000. It rests on solid granite bed rock. In 1872 a timber-crib dam was built to the height of 72 feet, the crib being built of cedar and tamarack logs, notched and bolted together, and solidly filled with loose stones of large size. A water-tight skin of pine planking is spiked to the upper face. During 1875-76 the dam was increased to a height of 100 feet by filling in a stone embankment on the lower side of the old structure, faced with heavy walls of dry rubblestone of large size. The downstream face wall is 15 to 18 feet thick at the bottom, diminishing to 6 or 8 feet at the top. Many of the stones weigh from 0.75 of a ton to 4.5 tons. The lower portion of the wall is 17.5 feet high, with a batter of 15 per cent. It is built of heavy stone in horizontal beds. The backing is tied to the stone by long iron rods. The upper portion is built with a slope of 45 degrees. A plank skin is firmly spiked on the upper face of the dam. This planking is of heart sugar pine, 3 by 8 inches, dressed. At the bottom the plank is fitted to bed rock and calked with pine wedges. There are three thicknesses on the lower 25 feet, two thicknesses on the next 35 feet, and one thickness on the upper 36 feet. A culvert, with foundation and walls built of heavy dry rubble covered with heavy granite slabs 16 to 18 inches thick, extends through the dam. Three wrought-iron pipes of No. 12 iron, 18 inches in diameter, pass through the water face of the dam. Their intakes are protected by a strainer. A valve is placed at the lower end of each pipe. The aggregate discharge of these pipes is 280 cubic feet per second. The dam is built V-shaped, with the angle, of 165 degrees, pointing up stream. The cost was $151,521. The wasteweir is over a crib of round cedar timbers, from 12 to 30 inches in diameter, firmly bolted together, with the foundation logs securely fastened to the bed rock with 1½-inch bolts. The cribs are solidly filled with granite blocks of various sizes. A plank fencing of 3-inch heart sugar pine is spiked on the water face. The crest of the original dam is 92.5 feet above datum line, being 4 feet longer than the crest of the main dam. A light superstructure of 4 feet allows the water to be raised to the height of the main dam. The wasteweir is provided with twenty-eight escapes, each 4 feet wide and 11 feet deep. These wasteways are closed when all danger from freshets is passed.

It is believed that the structure is sufficiently stable to allow a flood of 16,000 cubic feet per second to pass with safety through the wastes and over its crest. The water passing over the dam falls on bare granite bed rock, and thence down a steep gorge.[1]

Besides Bowmans Reservoir the company has the following reservoirs:

Reservoirs of the North Bloomfield Gravel and Mining Company.

Name.	Dam.		High-water area.	Altitude.	Capacity.
	Height.	Length.			
	Feet.	*Feet.*	*Acres.*	*Feet.*	*Cubic feet.*
Sawmill	39.2		80.6	5,780	2,000,000
Shotgun	14.0	50	26.2	6,410	3,423,816
Island	12.8		48.8	6,690	23,027,558
Middle	12.0		11.2	6,460	2,395,800
Round	11.0		8.1	6,590	2,907,630
Crooked	1.0		11.2		16,000,000

The combined storage capacity of these reservoirs is 961,754,804 cubic feet, or 445,257 24-hour miner's inches.

The main canal is the Bloomfield Ditch, which commences at Bowmans Lake and follows along the main ridge, between the South and Middle forks of Yuba

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[1] The above description of the Bowmans dams is essentially the same as written for Bowie by Hamilton Smith, jr., who planned and constructed the dams.

River, to the North Bloomfield Mine. Its length, including distribution ditches, is 55 miles, and it has a grade of 12 to 16 feet to the mile. It is 8.65 feet wide on top, 5 feet on the bottom, and 3.5 feet deep, with a capacity of 3,200 inches. The ditch was finished in 1876, at a cost of $466,467. The ditch and supports of the flumes are in fair condition, but the boxing of the flumes should be renewed in many places.

The following data, from Bowie, give the rate of loss by absorption, leakage, evaporation, etc.:

> Three thousand miner's inches of water, turned in during the dry season at the head of the Bloomfield Ditch, will deliver 2,700 inches at the gage, 40 miles distant. Two thousand four hundred inches of water, turned in at the head of the Milton Ditch, formerly delivered at the gage, 29.5 miles distant, 1,450 to 1,600 inches; but at present 2,500 inches, turned into the head of the ditch, delivers 2,000 inches at the gage.

Irrigation.

Only a small fraction of the water from the Bloomfield Ditch is used for irrigation, according to Supt. L. L. Meyers, of North Bloomfield. The total revenue from the water sold for irrigation does not exceed $25 per annum. This does not include some 200 inches which, as previously mentioned, is sent to French Coral through the Milton or Kate Hayes Ditch. Most of the water is used at the North Bloomfield Mine, and when not thus used is run to Badger Hill and Cherokee. There are no regular prices for water used for irrigation, nor are there any rules regarding the distribution of water for irrigating purposes. The people are allowed all they wish, provided the supply of water in the ditch is not reduced below a certain amount. A great deal of water is wasted by the irrigators. The reason the company does not measure the water which it sells to irrigators is that the revenue from that source is too small to warrant any expense, and the company is indifferent as to whether the people use the water or not. When the company's mine is being operated use is found for all the water the ditch can carry.

MARYSVILLE AND NEVADA POWER COMPANY.

This company has a water right at Goodyears Bar, on the North Yuba, of 20,000 miner's inches. It is intended to divert the water at this point and carry it to a point opposite Alabama Bar, where it will be used to generate power and be returned to the river.

At Alabama Bar the same company has another right of 10,000 miner's inches. It intends to divert this water from the river and carry it to a proposed reservoir at the Oregon House in the drainage basin of Dry Creek. This reservoir, with a dam 130 feet high, will have an area of 2,000 acres. It is at an elevation of 1,500 feet above tide. This elevation is sufficient to develop a large amount of power and leave sufficient head to deliver the water for irrigation and domestic uses to coast and valley cities.

The company also has rights at the Narrows for 25,000 inches, and owns 57 acres on both sides of the river at this point. It is intended to use this water for power and irrigation purposes.

Canals.

Daggett Ditch is being constructed. It takes water from the Yuba above Smartsville. The cost to date has been $3,000. O'Brien Ditch commences at the

Narrows, on the south side of the Yuba River. The cost of this ditch to date has been $16,000. The Alabama Bar Ditch is being constructed as rapidly as possible, and is to carry water from Alabama Bar to the Oregon House Reservoir. Tunnels and concrete aqueducts are to be used on the ditch instead of flumes. The tunnel which is to divert the water from the river and about 35 rods of the rock foundation for the aqueduct had been constructed at the time of examination in July.

Reservoirs.

Besides the reservoir at Oregon House Valley, the company has 10 storage lakes at the head of North Yuba River, which will hold water to the extent of 6,000 24-hour inches for five months in the year.

EXCELSIOR WATER AND MINING COMPANY.

The first water brought into Smartsville, Sucker Flat, and Timbuctoo was delivered in the spring of 1852 by the Union Ditch Company. The water was taken from Squirrel Creek by the Triunion Ditch, which was 7 or 8 miles in length and of a capacity when first dug of not more than 300 inches. Its cost was about $25,000. It was afterwards enlarged to a capacity of 1,000 inches, at an additional cost of $7,000. The company used a service reservoir and stored the water that came down at night, thus increasing the day supply. This was then regarded as quite an undertaking and provided a sufficient volume of water to supply a number of mining claims. Claims were then only about 100 by 120 feet, and required about 15 to 25 inches of water, and worked only the surface of the hills and bars in the little ravines. The price of water was about 50 cents per inch. The actual sales amounted to about $1,800 per week in the rainy season. In the dry season there was no water.

In the winter of 1852 other water was introduced to Sucker Flat in what was and is still known as The Miners Ditch. It was started in opposition to the Union Ditch Company, but the two companies consolidated before it was finished. This ditch took water from Deer Creek, about 1 mile east of Squirrel Creek. It was 8 miles long, with a grade of 15 feet to the mile, and cost $15,000. In 1858 it was enlarged to a capacity of 1,000 inches. It was abandoned in 1866, but it could be used at the the present time by cleaning it out and replacing the flumes.

The same winter, 1852–53, another company finished a ditch, the Riffle Box. This ditch was 15 miles long, 8 feet wide on top, and 4 feet wide on the bottom, and 3.25 feet deep, and had a capacity about the same as The Miners Ditch. It cost about $40,000. Water was taken from Deer Creek, near the town of Rough and Ready. Soon afterwards this company consolidated with the Union Company and formed what was known as the Triunion Water Company. They had at their disposal from 800 to 1,000 inches during the wet season.

During the winter of 1854–55 the survey of the Excelsior Ditch was made and work commenced. Water was delivered at Sucker Flat during the winter of 1856. The ditch had a grade of 10 feet to the mile, was 6 feet wide on top, 4 feet wide on the bottom, and 2 feet deep, and had a capacity of 800 inches. The ditch was 17 miles long, and also took water from Deer Creek between the Riffle Box and Miners ditches, but owing to its being more circuitous was longer than either of the others.

At the same time the Excelsior Canal Company commenced the South Yuba

Ditch. It took water from the South Yuba and joined their Deer Creek Ditch about 3 miles from Smartsville. It was built with a grade of 10 feet to the mile, was 8 feet wide on top, 6 feet wide on the bottom, and 2.5 feet deep, and had a capacity of 2,500 inches. Its cost was about $500,000. The South Yuba Ditch was not finished until the fall of 1859. The length was about 16 miles from the South Yuba to Deer Creek. This ditch tapped a perennial stream reinforced by stored water, so it was very soon decided to carry it through to Sucker Flat by a different route from the original one. This lower part is about 10 miles long, with about five-eighths of a mile of flume. It was built on a grade of 10 feet to the mile, was 9.5 feet wide on top, 7 feet wide on the bottom, and 3 feet deep, and had a capacity of 3,000 inches. The cost was $260,000. It was known as the China Ditch, and was finished in 1860.

In the summer of 1857 what is known as the Boyer Ditch was commenced, and finished early in 1858, by David Boyer. The Boyer Ditch took water from Deer Creek and discharged into the Boyer Reservoir. It was 18 miles long, and had a grade of 15 feet to the mile and a capacity of 1,500 inches. Its cost was about $120,000. In 1859 the Boyer Ditch consolidated with the Triunion Company and the name was changed to the Union Ditch Company.

Early in 1861 the Excelsior Ditch and the Union Ditch were consolidated under the name of the Excelsior Canal Company. In 1857 it became the Excelsior Water Company. Up to this time the business of the company had been to sell water to the various miners in the vicinity of Smartsville. In 1876 it consolidated with some of the mines between Timbuctoo and Smartsville, and became the Excelsior Mining Company. In 1877 it became the Excelsior Water and Mining Company by taking in additional mines in the vicinity of Smartsville. The company has not done any mining since 1896, when their permit was revoked by the United States engineers. Nearly all the water at the disposal of the company is at the present time used for irrigation.

Besides the above ditches the Excelsior Water and Mining Company at the present time has the following ditches:

ROUGH AND READY DITCH.

This ditch was constructed in 1850. It takes water from Deer Creek, about 5 miles east of Nevada City. It is 16 miles long, with a grade of 14 feet to the mile and a capacity of 500 inches. The cost was $60,000. There is a small diverting dam in Deer Creek at the head of the ditch, 8 feet high and 117 feet long on the crest. The ditch delivers water at Rough and Ready. All the water was formerly used for mining, but it is now used for irrigation.

NEW TOWN DITCH.

This ditch is 8 miles long, and has a grade of 10 feet 8 inches to the mile and a capacity of 300 inches. It takes water from Deer Creek below Nevada City and runs to Kentucky Flat.

WOODS RAVINE DITCH.

This ditch was built in 1850. It is 4 miles long, on a grade of 8 feet to the mile, and has a capacity of 200 inches. It heads in Woods Ravine near Nevada City and runs to Rush Creek.

PLEASANT VALLEY DITCH.

This ditch takes water from Deer Creek and delivers it to Hudson Mine. It is 3 miles long, has a grade of 7.6 feet to the mile, is 28 inches wide on top, 20 inches wide at the bottom, and 20 inches deep, and has a capacity of 250 inches. All the water is used for irrigation in Pleasant Valley except 50 inches, which is used at the mine.

OUSLEY BAR DITCH.

This ditch was built in 1852 at a cost of $20,000. It is 12 miles long and has a grade of 11 feet to the mile and a capacity of 600 inches. It takes water from the Big Ravine about 300 feet below Union Reservoir and distributes it to the vicinity of Reeds Station. This ditch was extended by keeping upon a light grade and not letting the water drop into Magonigal Ravine. It now commands all the land north of Dry Creek and west of the ditch. The length of the extension was 5.5 miles and the cost $7,526.

FARM DITCH.

This was built in 1876. It heads in Big Ravine opposite the Timbuctoo Ditch and irrigates the Bonanza Ranch. The size of the ditch varies. For the first mile, to Sanfords Ravine, it has a grade of 0.5 inch to the rod, is 7 feet wide on top, 5 feet wide on the bottom, and 2 feet deep, and has a capacity of 2,000 inches. From that point for 1.5 miles it is 5 feet wide on top, 3 feet wide on the bottom, and 2 feet deep, and has a capacity of 1,000 inches. From there to the reservoir, a distance of 3 miles, the capacity is 600 inches. The total length of the ditch is 5.4 miles, 300 feet of which is in flumes. The ditch at the present time will not carry more than 400 inches. It cost $10,000. Before reaching the reservoir a tunnel was dug a distance of about 300 feet, so that water could be discharged into the Ousley Bar Ditch. From the Farm Reservoir there are two main ditches that lead the water over the irrigated ground.

SPENCEVILLE DITCH.

This ditch takes water from the China Ditch near Smartsville, and was built in 1890 at a cost of $10,000. It is 7 miles long on a grade of 12 feet to the mile, is 6 feet wide on top, 3 feet wide on the bottom, and 2.8 feet deep, and has a capacity of 600 inches.

The total length of the Excelsior Company's ditches is about 110 miles, 60 miles of which are in use. The total cost was more than $1,200,000. The whole mining district from Nevada City to the Sacramento River, bounded by the Yuba and Bear rivers, can be supplied by the waters of this company.

The expense of maintenance of these ditches is low compared with ditches located higher in the mountains, for the reasons that the ground at this altitude rarely freezes and no snow lies in winter, and landslides are of rare occurrence. As few flumes are required between Deer Creek and Smartsville, the banks of the ditch have settled and become covered with a permanent growth of grass and bushes, and a break is rare even in the severest rain storms.

DAMS.

The dam of the Excelsior Water and Mining Company, in the South Yuba, was constructed in 1878. Square timbers were drift-bolted to one another and leaded to the bedrock. Through each timber, 2 feet from the end, a 1¼-inch rod was bolted and extended back and leaded in the bed rock. In the construction 18 tons of 1¼-inch iron was used for braces, bolts, pins, etc. The dam is 26 feet high, 60 feet long on the bottom, and 120 feet long on the crest. It is planked on the upstream side with 2-inch plank, and the rock was piled on the upstream side to within 4 feet of the top. It cost about $10,000. At the present time the dam is filled to the top with tailings and is in as good condition as when built. This dam is of such a peculiar type that diagrams of it are shown (fig. 4, p. 139).

The dams in Deer Creek, at the head of Rough and Ready, Boyer, and other ditches, are of the same type of construction as the South Yuba Dam. The Newtown and Pleasant Valley dams are wing dams.

RESERVOIRS.

The Excelsior Company owns reservoirs as follows:

Union Reservoir, located in S. E. ¼ of sec. 24, T. 16 N., R. 6 E., has a capacity of 6,000 24-hour inches. Its area is about 40 acres. It was built in 1859 by constructing an earthen dam 700 feet long, 30 feet high, 5 feet wide on the crest, and 100 feet wide on the bottom, having a riprap stone wall laid on the inside. Its cost was $20,000.

Boyer Reservoir, located in N. ½ sec. 2, T. 15 N., R. 6 E., has an area of 20 acres and a capacity of 1,000 24-hour inches. It was built in 1858, and has a dam similar in type to the one at Union Reservoir, 600 feet long, 8 feet wide on the crest, 78 feet wide on the bottom, and 20 feet high. Its cost was $4,000.

Besides these there are a number of small reservoirs and a number of undeveloped reservoirs, the sites for which the company owns. At Indian Springs, by building a dam 100 feet high, a reservoir could be made which would cover 246 acres and store 296,000 24-hour inches. This reservoir would have a watershed of about 10 square miles, but it could be filled from existing ditches. At the Garsaway Ranch, by building a dam 105 feet high and 1,080 feet long, there could be stored 90,000 24-hour inches, making a reservoir with an area of 139 acres.

RIGHTS IN DEER CREEK.

The Excelsior Water and Mining Company claims and holds all the existing water rights on Deer Creek from 1 mile east of Nevada City to where it flows into the main Yuba. Hence practically all Deer Creek water belongs to the Excelsior Company. There may be some water used above the system, but it all comes back to the stream above the head of the Rough and Ready Ditch. All the water that finds its way into the Excelsior Ditch below the Rough and Ready Ditch in the summer time is waste water. It consists of sewage of the town of Nevada, waste from the mines, and waste from irrigation.

WATER RIGHTS IN SOUTH YUBA.

The company claims and holds all the South Yuba water, and water from all its tributaries below or west of the South Yuba Water Company's systems. It claims that no other company has any prior right to any natural waters that are discharged into the South Yuba or any of its tributaries below or west of the South Yuba Canal Company's system.

Nearly everyone having land situated so that it can be watered from the ditches does more or less irrigating. The crops irrigated are alfalfa, orchards, gardens, and grain, the latter being irrigated only during very dry years.

In 1898 the area irrigated with water from this system was 1,884 acres; in 1899, 1,352 acres, and in 1900, 1,251 acres.

The company's charges for water depend on the kind of crop irrigated. Six dollars per acre per season is charged for grass, and $5 per acre per season for orchards. Irrigators are allowed all the water they want. They are supposed to use it by rotation, but water is so abundant that there is generally no trouble in getting it except on a few smaller ditches, such as the Spenceville Ditch.

The waste of water due to its abundance and to unskilled irrigation is great. Fully 60 per cent of water turned on the fields runs off and into the nearest ravine. All the water which runs into Deer Creek above the headgate of the China Ditch is picked up again by that ditch and utilized, but all that runs in below is wasted. That which runs into Big Ravine above the Farm Ditch is saved.

The value of good land above the ditch is from $12 to $15 per acre; the same class of land below the ditch brings $25 to $30 per acre. The soil is a red clay containing a small percentage of iron and copper. It is from 2 to 5 feet deep, but when properly irrigated and worked it will raise good crops. Hay in 1900 was worth $10 per ton, and most of the crop was shipped to Nevada City and Grass Valley.

NEW BLUE POINT MINING COMPANY'S DITCH.

In 1858 the Nevada Reservoir Ditch Company built a ditch from Wolf Creek, a tributary of Bear River, to the gravel mines near Smartsville. Water was turned into the ditch by a crib dam in Wolf Creek about 15 feet high. The ditch is 30 miles long and on a grade of 12 feet to the mile. The first 27 miles it is 6 feet wide on top, 4 feet wide on bottom, and 2.5 feet deep, with a capacity of 800 miner's inches. The last 3 miles had a capacity of 1,200 inches. The total cost was about $75,000. Along the line of the ditch there are several drops which might be utilized to develop power—one 4 miles from the headgate, of 75 feet; another 10 miles from the headgate, of 150 feet; a third, 28 miles below, of 150 feet; and one 29 miles below, of 150 feet.

The company owns two small reservoirs along the line of the ditch which are situated about 1 mile apart. The lower one is about 3 miles from the end of the ditch. They have an area of 20 and 15 acres respectively. During the dry season the ditch depends on the waste water from the Grass Valley mines.

Very little water is used from this ditch for irrigation, there being only about 100 acres watered in all. Five dollars per acre per season is charged for the use of water. The customer is allowed as much as he wants whenever he wishes it. The water is principally used at the Blue Point Mine. The ditch is now the property of the New Blue Point Mining Company.

The South Yuba Water Company supplies water to the mines near Grass Valley, so the water which this ditch carried from a tributary of Bear River to the Yuba is returned to the drainage basin from which it was diverted.

POWER STATIONS IN THE BASIN OF YUBA RIVER.

A number of electric power companies utilize the water of Yuba River. The Central California Electric Company has a station near Newcastle, and also one near Auburn. At the Newcastle station water is taken from the South Yuba Water Company, to which the electric company is allied, and carried to a power house 6,400 feet distant in a 24-inch riveted sheet-steel pipe. From there the power developed is transmitted 30 miles to Sacramento, at 15,000 volts, where it is used for lighting and general purposes. The Auburn station utilizes a fall of 200 feet within a distance of half a mile, found on the Bear River Canal of the South Yuba Water Company, about 1 mile south of Auburn. A reservoir, capable of holding a day's supply of water, was built at the head of Auburn Ravine. A pipe of riveted sheet-steel 3,100 feet in length, with a diameter ranging from 56 inches down to 36 inches, connects the reservoir with the power house. The power generated is also transmitted to Sacramento, 34 miles distant.[1]

The Bay Counties Power Company has a station on the South Yuba River, about 6 miles from Nevada City. Water is diverted from the river about 1 mile above Perdons Bridge by a crib dam 38 feet high and 150 feet on the crest, the cost of which was $18,000. The flume is 4 miles long, 5 feet on the bottom, 4.5 feet deep, and has a grade of 1.5 inches to the rod and a capacity of about 7,000 inches. Its cost was $55,000.

On Rock Creek, which is a tributary of the South Yuba, there is an artificial reservoir with a capacity of 40,000 24-hour inches under 6-inch pressure. This reservoir is formed by a crib dam across Rock Creek, built in 1898 at a cost of $25,000. The dam is 54 feet high and 251 feet long. The ditch from the dam to the power house has a capacity of 750 inches, and cost $7,500. There is also a small emergency reservoir at the top of the hill above the power house, which has a capacity of 500 inches for one hour. In case of a sudden call for power the water is drawn from the Rock Creek Reservoir. It takes water one and one-half hours to come to the power house, so the emergency reservoir serves until the Rock Creek water reaches the power house. The power house was finished in 1896, and subsequently enlarged. At present it contains four alternating-current Stanley generators, each having a capacity of 500 horsepower, which generate a current directly at a potential of 5,500 volts. Each generator is directly connected to and driven by two sets of water wheels. The power generated is transmitted 4 miles to Nevada City, and thence 4 miles to Grass Valley, where it is used to supply all the public and private lights and the small demands for power. Diverting lines are carried to the mining districts, and power is now supplied to run motors of from 1 to 450 horsepower, which are used to operate pumps, hoists, and other mining machinery. This plant is of great importance to this region because of the high price of fuel, which caused the shutting down of many mines. The company delivers a current for power at an average price of $5 per month per horsepower for constant loads.

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[1] The description of the Newcastle plant is condensed from an article in Electric World for December 18, 1897; that of Auburn plant from the American Electrician for September, 1899.

The same company has a station near Dry Creek, 20 miles northeast of Marysville. The water is taken from the flume at Colegate and conveyed through 25 miles of ditch to the forebay, then to the power house through 850 feet of 30-inch riveted sheet-steel pipe, affording an effective head of 296 feet.

The power is transmitted by pole line to Marysville, a distance of 20 miles, and used for lighting the city and general power purposes. There is also an 8-mile circuit, delivering lights and power for mining purposes at Browns Valley, both power and light being taken from each circuit. They also send power to the power house of the Nevada division when that power house is unable to carry its load.

College Station is also owned by the Bay Counties Power Company, and is situated on the main Yuba River at a point about 4 miles above the junction with the South Fork. Construction was commenced in May, 1899, and is still being continued. The company holds the Page lease of the mechanical privileges of the water of Browns Valley district, and claims an additional right to 10,000 inches in the North Yuba at the headgates.

The dam in the North Yuba has been raised to a height of 37 feet, and a new flume, 6 by 7 feet, on a grade of 13 feet to the mile, with an estimated capacity of 300 cubic feet per second, has been built from the dam to Colegate, a distance of 7.6 miles. From the forebay to the power house there is a drop of 695 feet, which is used to develop power. The water is to be conveyed to the wheels in five 30-inch pipes, two of which are now laid. They have a length of 1,600 feet, the first 700 feet being riveted steel, and the lower 900 feet cast iron.

The company intends to deliver power at San Francisco and intermediate points, a total distance of 140 miles. The total cost of the plant will be $3,000,000, $2,300,000 having already been expended.

At Dobbins a reservoir is being built to be drawn on in case the water in the flume has to be shut off. Its capacity will be about 35,000,000 cubic feet. Dobbins Creek will be able to fill it during the rainy season. If it becomes necessary to refill it in the summer, part of the water which runs to waste during the period of minimum load is to be used to lift the balance up to the lake. When the reservoir is drawn on the water will be used twice—once to generate power at the forebay under a head of 330 feet, and again at the power house under the 665-foot head.

IRRIGATION INVESTIGATIONS ON CACHE CREEK.

By J. M. Wilson, C. E.,
Agent and Expert.

INTRODUCTION.

The district to which the investigations described in this report were directed is the watershed and valley of Cache Creek (Pl. XI). It embraces the county of Yolo and parts of Lake and Colusa counties. All of Lake County is mountainous, as is also that part of Colusa County which is drained by Cache Creek. The western boundary of Yolo County is the crest of the eastern ridge of the Coast Range. The eastern slope of this ridge covers about one-third of the county and is of little value agriculturally, except as a stock range. To the east of this mountain region lies a border of low hills; beyond, the great Sacramento Valley stretches away in an almost unbroken plain, from Suisun Bay on the south to Red Bluff on the north, a distance of about 140 miles. The topography is well shown in the section of Drake's relief map of California as given in Pl. XII. Yolo is the second county north from the bay, and lies directly across the river and west from the city of Sacramento.

As with most of the agricultural country west of the Missouri River, the stockman was the first occupant. Pasturage was abundant, and continued throughout the year. The mild winters seemed to make unnecessary the providing of food for stock, as in the more rigorous climate of the East. Following the discovery of gold in 1848 came the rapid development of the mines and the golden age of California, bringing a ready market for all staple products at remunerative and sometimes fabulous prices. The stockman had every encouragement to expand his herds, but with the winter of 1861–62 came unprecedented floods and disaster. It was estimated that 40 per cent of the cattle in Yolo County perished from the effects of storms, floods, and lack of food. The spring of 1862 was again favorable, and, stimulated by good prices, which still prevailed, the cattlemen sought to retrieve their losses. With 1863 came scanty rainfall, to be followed again in 1864 by a drought of unprecedented severity. There was no food for the stock, and it either perished or was sold for a song, to be driven over the mountains into Nevada. The cattlemen were ruined. The reign of the vaquero was over.

In the meantime the agricultural interests were gaining ground, and it had become apparent that the returns from tilling the soil, though more modest, were less precarious than those from stock raising. It had also developed that the soil and climate were particularly adapted to the production of small grains. Prices were good and shipping facilities improving. From experimenting with a few acres in 1849 and 1850 the area cultivated was increased until in 1860 there were, in round numbers, 39,000 acres seeded, chiefly to wheat and barley. By 1866 the acreage had increased to 87,000. From this time forward the increase was steady till in 1900 the total area reported under cultivation in wheat and barley alone is 249,848 acres.

Before California became a part of the United States the lands extending along both sides of Cache Creek from the head of the Capay Valley to Sacramento River had been granted away by the Mexican Government. The Rancho Canada de Capay extended from the head of the valley to near the present site of the town of Madison, a distance of about 8 leagues, and contained 9 square leagues. Below this the Guesisosi, or Gordon, grant extended for 2 leagues down the stream, and contained 2 square leagues. The Rancho Rio Jesus Maria, or Hardy grant, extended from the east line of the Gordon tract west to the Sacramento, and contained 6 square leagues. These grants were subsequently confirmed by the United States Government.

The land laws in force for several years after California became a State favored the acquisition of large bodies of land by single individuals. Advantage was taken of this by the early settlers, many of whom acquired large landed estates, and their extensive holdings have, by keeping the population sparse, been unfavorable to the development of the country.

CACHE CREEK.

Cache Creek has its rise in the mountains of Lake and Colusa counties. Its principal and most reliable source is Clear Lake, which occupies about 80 square miles of Lake County and has a watershed of about 420 square miles. It is also fed during the rainy season and early summer by the north branch of Cache Creek, which, with its tributaries, rises in the northern part of Lake County and the western part of Colusa County. No continuous record of the flow of the stream has, so far as I can learn, ever been kept, but during the rainy season it is estimated to range from 500 to 1,200 cubic feet per second under ordinary conditions to 30,000 cubic feet per second in time of extreme flood. This flood flow lasts for a few hours only. During the winter the North Fork and its branches, with a watershed of about 200 square miles in the eastern part of Lake County and the western part of Colusa County, discharge a large volume of water, but with the close of the rainy season their flow diminishes, and after the middle of June their discharge is ordinarily of little importance. On June 29, 1900, the discharge from the North Fork, as measured by A. E. Chandler, of the University of California, was only 5.1 cubic feet per second. On the same date he found that the flow in the main stream, which is fed by Clear Lake, was 161.4 cubic feet per second.

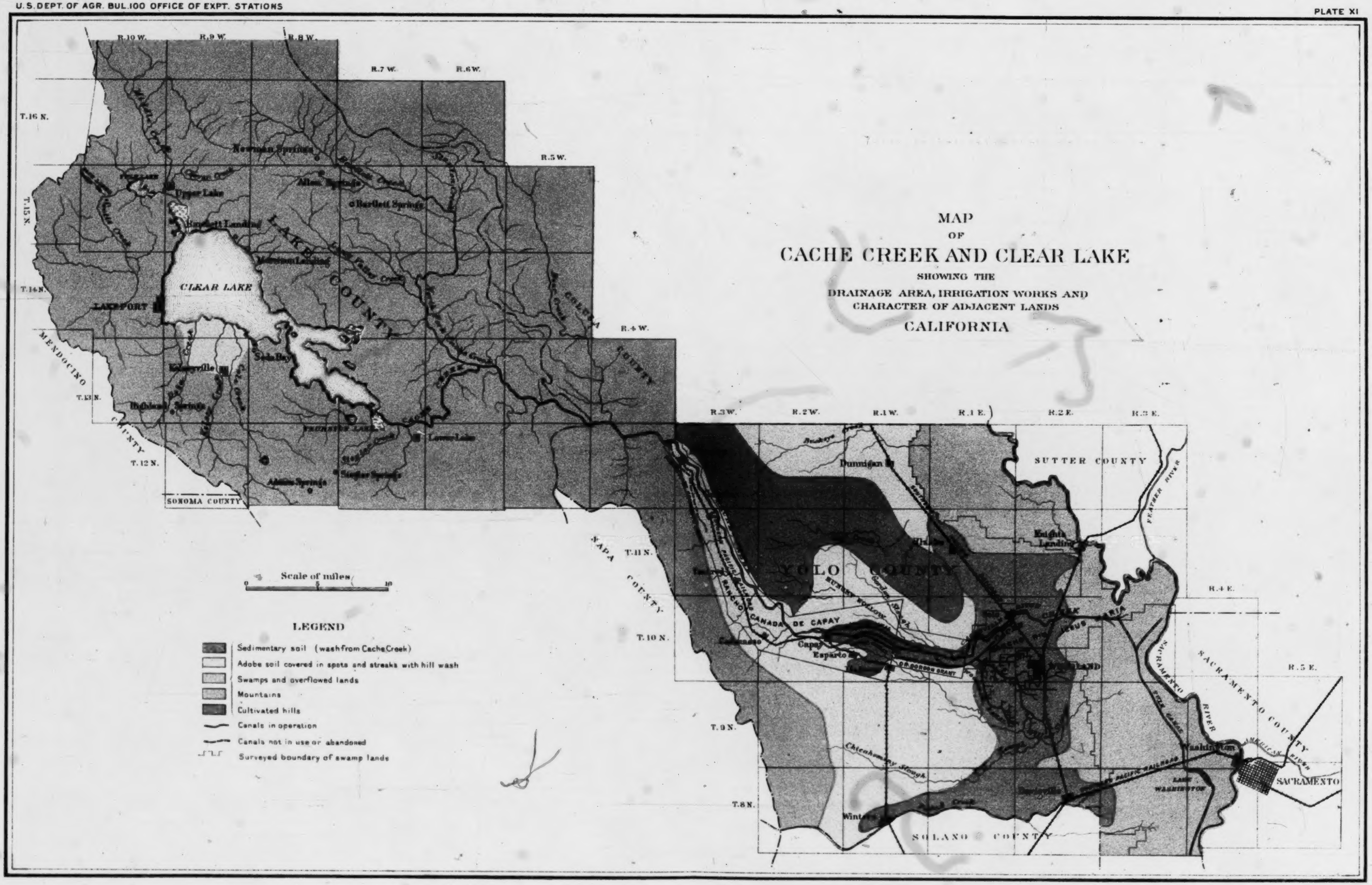
During the summer of 1900 we made gagings on Cache Creek, as follows:

Gagings of Cache Creek, 1900.

Point of gaging.	Approximate distance from Clear Lake.	Date.	Discharge.
	Miles.		*Cubic feet per second.*
One hundred feet below bridge at Lower Lake	2	Aug. 20	39.65
County bridge at Rumsey	30	June 29	166.77
Do	30	Aug. 27	27.64
On line between J. F. Hughes and Robert Boyle, in sec. 15, T. 11 N., R. 3 W	38	June 29	167.47
Sec. 6, T. 10 N., R. 2 W	45	....do...	173.60
County bridge at Capay	50	June 28	161.60
County road at Esparto	53	June 30	152.69
County bridge at Madison	56	....do...	140.87
Stephens Bridge	62	July 3	*a* 75.88
Nelson Bridge	70	....do...	53.04
East line sec. 12, T. 10 N., R. 2 E	75	....do...	*b* 51.32

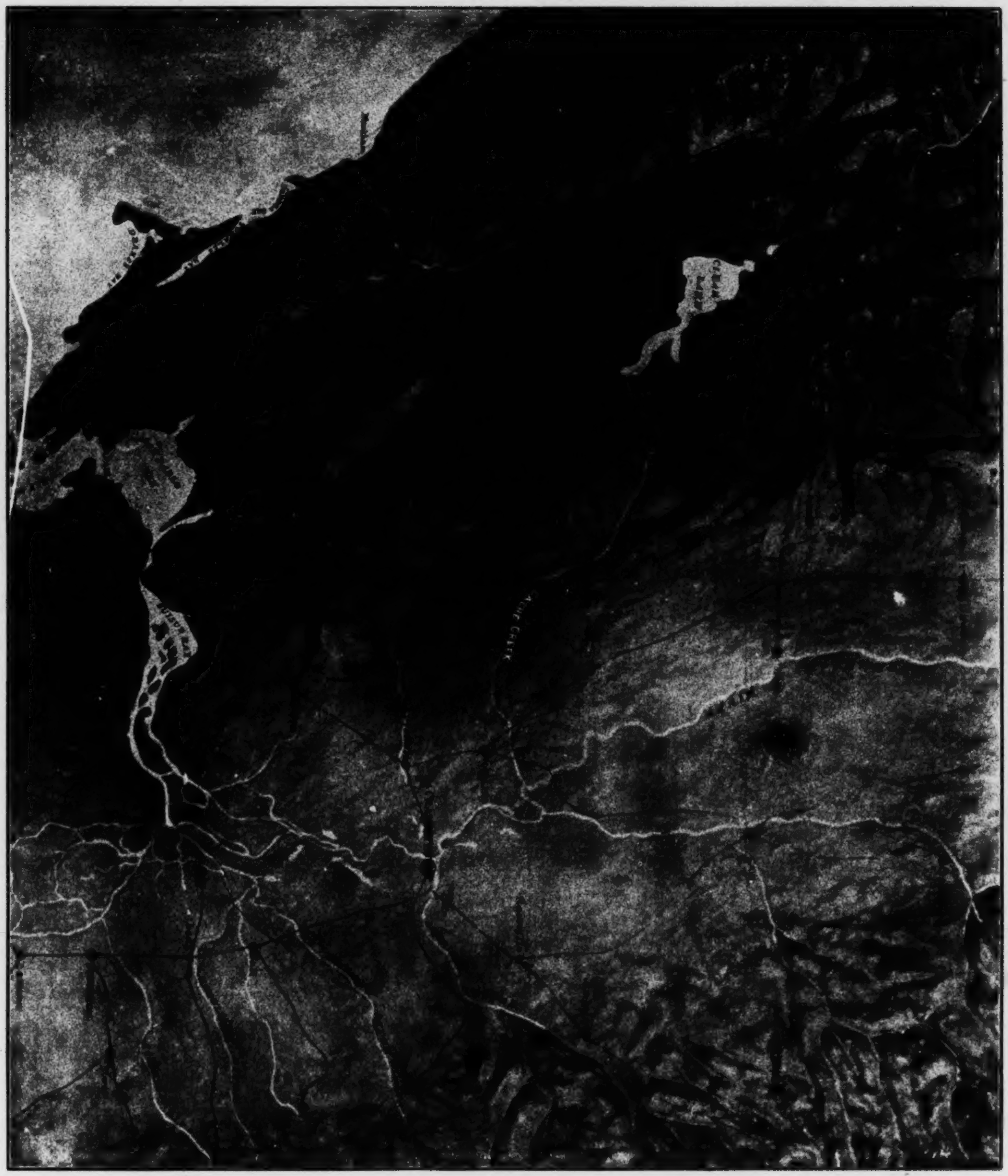
a On July 3 the Moore Ditch was diverting 60.52 cubic feet per second between Madison Bridge and Stephens Bridge, making the total flow in this section of the stream 136.40 cubic feet per second.

b All water passing this point is wasted in the sink or passes into Sacramento Slough.



MAP
OF
CACHE CREEK AND CLEAR LAKE
SHOWING THE
DRAINAGE AREA, IRRIGATION WORKS AND
CHARACTER OF ADJACENT LANDS
CALIFORNIA

R.10 W.
R.9 W.
R.8 W.
R.7 W.
R.6 W.
R.5 W.
R.4 W.
R.3 W.
R.2 W.
R.1 W.
R.1 E.
R.2 E.
R.3 E.
R.4 E.
R.5 E.
T.16 N.
T.15 N.
T.14 N.
T.13 N.
T.12 N.
T.11 N.
T.10 N.
T.9 N.
T.8 N.
Newman Springs
Allen Springs
Bartlett Springs
Upper Lake
Bartlett Landing
LAKE COUNTY
Lakeport Landing
CLEAR LAKE
LAKEPORT
Soda Bay
Kelseyville
Highland Springs
Lower Lake
Adams Springs
Siegler Springs
MENDOCINO COUNTY
SONOMA COUNTY
NAPA COUNTY
COLUSA COUNTY
SUTTER COUNTY
YOLO COUNTY
SOLANO COUNTY
SACRAMENTO COUNTY
Dunnigan
Knights Landing
Capay
Esparto
CANADA DE CAPAY
RANCHO
Woodland
Davisville
Winters
Putah Creek
Chickahominy Slough
Washington
East Washington
SACRAMENTO
Sacramento River
Feather River
American River
Southern Pacific Railroad
Scale of miles
0
5
10
LEGEND
▨ Sedimentary soil (wash from Cache Creek)
☐ Adobe soil covered in spots and streaks with hill wash
▨ Swamps and overflowed lands
▨ Mountains
■ Cultivated hills
Canals in operation
Canals not in use or abandoned
Surveyed boundary of swamp lands



SECTION OF DRAKE'S RELIEF MAP, SHOWING CLEAR LAKE AND CACHE CREEK DISTRICT.

In addition to the above, A. E. Chandler, of the University of California, kindly furnishes the following:

Gagings on Cache Creek, 1900.

Point of gaging.	Approximate distance from Clear Lake.	Date.	Discharge.
	Miles.		*Cubic feet per second.*
At outlet of Clear Lake	00	July 17	106.90
Above confluence with North Fork	12	June 29	161.40
Above confluence with Bear Creek	24	June 27	156.00
County bridge at Rumsey	30	June 25	189.00
Do	30	July 20	92.60
North of Tancred	40	....do...	89.84
One mile west of Capay	50	July 21	88.10

The two sets of gagings give a fair idea of the summer flow of the stream, and the two gagings at Rumsey June 29 and August 27 show how the flow diminishes as the season advances.

In the summer of 1898 the water ceased to flow from the lake into Cache Creek, and during this season the water of the lake reached the lowest stage on record, being nearly 1½ feet below the low-water mark of 1873, which up to this time had always been considered the extreme of low water.

A further study of the gagings made during the summer of 1900 shows that a considerable portion of the water of this stream sinks into the coarse gravel which has accumulated in the channel where the stream enters Sacramento Valley proper and where the steep grade of the channel ends. There is here a stretch of about 7 miles, extending from above Capay to a point near Madison Bridge, where the bed of the stream usually shows no running water after the 1st of August. Near the Madison Bridge the stream again begins to flow, and at the Moore Dam, 4 miles below, it again reaches a maximum. Below this it sinks again. A comparison of the measurements in the first series of gagings taken June 28 and July 3, inclusive, beginning at Rumsey and extending to the canal through the sink east of Woodland, shows where the losses take place when there is enough water to keep the flow in the channel continuous.

Much of the loss of water shown between the gorge above Capay and the Capay Bridge occurs in the last mile. The loss from Capay down to Madison Bridge is quite regular. After Madison Bridge is passed the waste is small. The sum of the volumes in the Moore Ditch and in the stream at the Stephens Bridge may be fairly assumed as the flow in the neighborhood of the dam. The loss between the Stephens Bridge and Nelson Bridge seems quite heavy, but part of this was diverted by the pumping plants which were in operation along this section at the time these measurements were in progress. The loss between Nelson Bridge and Hennigen's is not great, and evaporation would account for most of this. All the water passing Hennigen's is wasted except the small volume used for stock. Later in the season when the flow is not continuous the proportion of loss at all points is greatly increased.

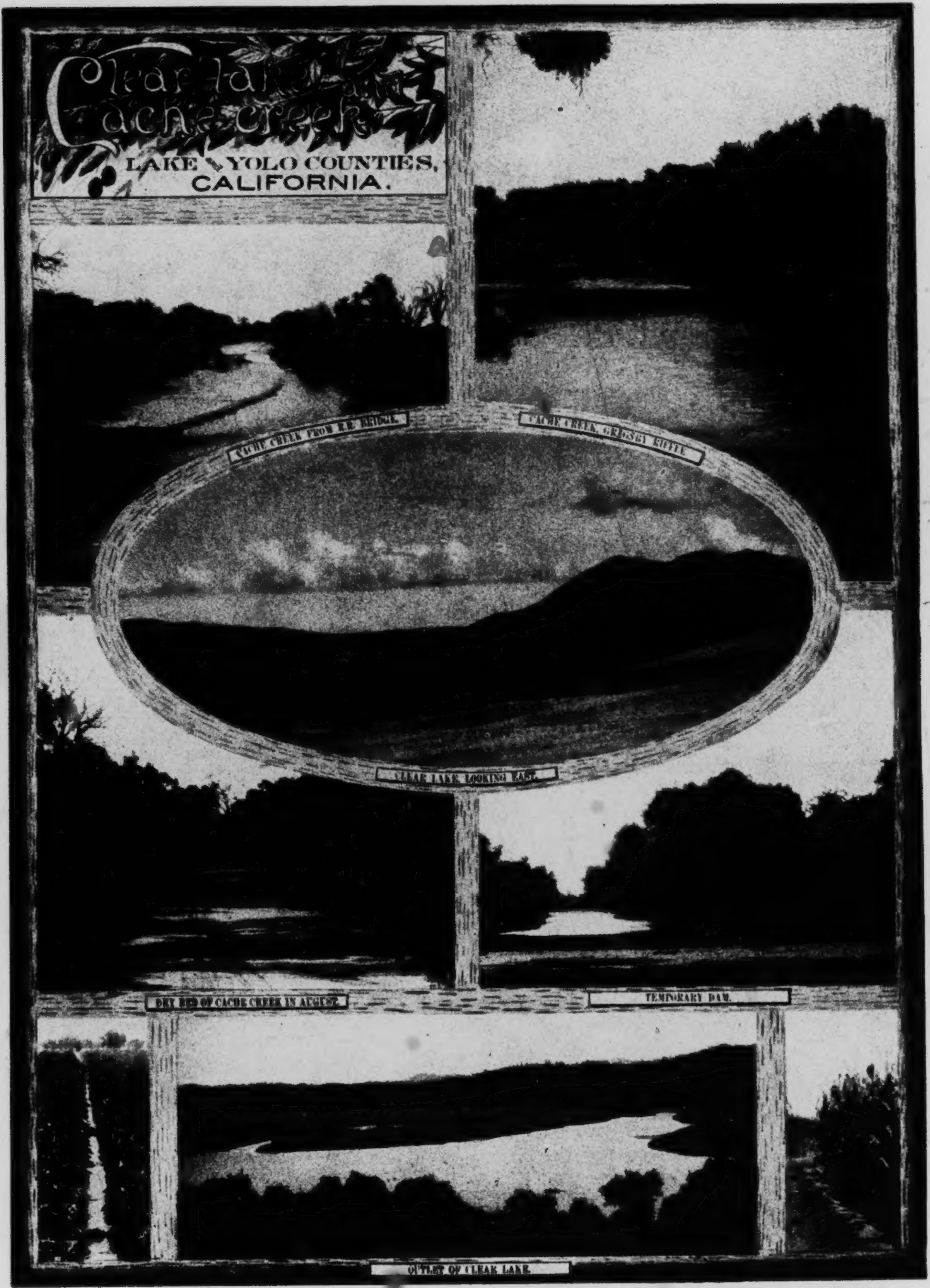
For the first few miles after leaving Clear Lake the course of Cache Creek is through a comparatively open country. For the next 25 miles it is a mountain stream, flowing over a steep and rocky bed and through deep gorges. About 30 miles from the lake it passes into Capay Valley, through which it flows for about 20 miles, when it emerges into the main Sacramento Valley. Its course here is almost directly eastward some 25 miles to the point where it discharges into the canal which drains the country east of Woodland. The fall for the first 3 miles after leaving the lake is about 22 feet. The next 9 miles brings us to the junction with the North Fork. The fall in this section is about 350 feet. The fall between this point and Rumsey, where it enters the Capay Valley, some 20 miles below, is about 500 feet. In Capay Valley the fall is about 200 feet. Through the Sacramento Valley the fall to the slough is about 150 feet. The total fall from Clear Lake to the town of Yolo is approximately 1,275 feet.

STORAGE.

Clear Lake lies about 80 miles north of San Francisco, in one of the valleys of the Coast Range, at an elevation of 1,325 feet above sea level. The lake and its watershed occupy the larger portion of the county of Lake. Its area is about 80 square miles, and it receives the drainage from about 420 square miles of rough, mountainous country. The moisture precipitated on these slopes soon finds its way through the steep channels of the mountain streams into the lake. The most important of these streams are Scotts Creek, Middle Creek, Clover Creek, Kelsey Creek, Cole Creek, and Siegler Creek. None of them contributes much water to the lake except during the rainy season. The outlet is toward the southeast through a break in the eastern ridge of the Coast Range. This channel where the stream leaves the lake is through a low, flat valley, and is in this part from 30 to 100 feet wide and from 4 to 8 feet deep. It is, except at the extreme lower end of this section, at the same level, and is for all practical purposes a continuation of the lake.

At the end of this section the water passes over what is known locally as Grigsby Riffle. The flow through this channel would naturally tend to lower the outlet and to finally drain the lake, but this tendency is counteracted by Siegler Creek. This stream enters from the south nearly at right angles to the outlet. It is a mountain stream carrying, in times of flood, much débris of coarse gravel and small stones. Grigsby Riffle is the bar which this stream has built up in the channel from the lake. The fall in Siegler Creek for the last mile of its course is about 30 feet, and above it is still steeper. The fall in Cache Creek below the riffle is moderate, not over 5 or 6 feet to the mile, and the current is much impeded by willows and other growth. The constant flow from the lake hardly suffices to keep the channel open to its full capacity. When the lake is at its low-water stage and Siegler Creek in flood, its discharge is sufficient to gorge the outlet below the riffle to such an extent that the water sets back into the lake with a marked current. At such times the deposit on the bar or riffle accumulates faster than it can be carried away, and tends to permanently raise the level of the lake. Some fears have been entertained by dwellers along the shore and owners of lands lying along the lake that serious damage may be caused in this way, and some attempt has been made to prevent this by changing the channel of Siegler Creek near the mouth, throwing the discharge farther eastward, below the riffle. Some digging and plowing has also been done on the riffle in times

PLATE XIII.



Clear Lake and Cache Creek
LAKE and YOLO COUNTIES,
CALIFORNIA.

CACHE CREEK FROM R.R. BRIDGE.

CACHE CREEK, CROSBY RIFFLE.

CLEAR LAKE LOOKING EAST.

DRY BED OF CACHE CREEK IN AUGUST.

TEMPORARY DAM.

OUTLET OF CLEAR LAKE.

of low water with the purpose of loosening the material, so that it may be carried down by the current. The water of the lake, starting at the riffle from a state of rest over a not very steep grade, has little transporting power and, with the flat grade and clogged channel of the section below, any material moved in this way from the riffle is deposited at a point a little lower down. While the diversion of Siegler Creek and the work on the riffle may, for the time being, prevent the raising of the water level, the ultimate effect is to make the bar a more permanent and effective obstacle to the passage of the water. The outlet of the lake being thus impeded, the water accumulates during the rainy season, causing a fluctuation in the surface from extreme low to extreme high water of some 12.7 feet. The ordinary range of fluctuation is much less than this. The variation between mean high and mean low water is about 5.5 feet. The highest stage was reached January 25, 1895, and the lowest November 20, 1898. The extreme of high water causes great inconvenience to dwellers on lands contiguous to the lake and also interferes seriously with navigation, the ordinary wharves and landings under such conditions being all submerged. The lake is not deep at any point, the extreme depth over a small area ranging from 40 to 50 feet. Along the borders, especially in the neighborhood of the points where it is desirable to make landings, the water is shoal and grown up with tule or coarse water grasses. At extreme low water a considerable body of this tule land is partially drained and a large area of mud flats exposed to the action of the sun, producing conditions which are a serious menace to the health and prejudicial to the reputation of the towns on the lake as health resorts. The approach to the ordinary landings is also cut off at such times, thus interfering with the navigation of the lake. By the improvement and control of the outlet all these difficulties might be overcome. This would require the straightening, widening, and deepening of the channel from the lake to the point where the stream begins to fall rapidly, and the construction of a system of regulating works adequate for the passing of a large volume of water when the level of the lake approaches the high-water danger point. When the danger is past, these gates could be closed and the water passed down through the channel as needed for use below. By so conserving the waters the level of the lake need never fall to the low stage which it now often reaches. If the range of levels were confined to from 3 feet above extreme low water to 8 feet above, the evil effects of both extremes would be avoided; it would then be possible to make permanent wharves and to reclaim all land above the high-water mark fixed. Siegler Creek could be disposed of by diverting it into the lake farther west, above and south of the point where the channel leaves the lake proper. The waters of Siegler Creek would be thus conserved and the débris which now interferes and chokes the channel would gradually fill up and render useful a considerable body of now worthless tule land near the lower end of the lake, which affords a large evaporating surface, without adding materially to the available storage capacity of the lake.

In the accompanying plate (XIV) the upper diagram shows graphically the rainfall in inches on Clear Lake watershed for each month for a period of nine years, 1891-1899. It is the average reported by three observers: D. C. Rumsey, of Lakeport; F. M. Porter, of Kono Tayee, and W. A. Maxwell, of Kelseyville. The second diagram shows the fluctuations of the surface of Clear Lake in feet for the same period and is constructed from three sets of observations made by D. C. Rumsey, of Lakeport; Captain Atherton, of Lakeport, and F. M. Porter, of Kono Tayee. The zero line in this diagram is the extreme of low water recorded in these observations. This occurred November 20, 1898. A study of these two diagrams will show how the level of the lake fluctuates in response to the precipitation in the watershed and how the impeded outlet of the lake retards the escape of the water and helps to maintain the flow in Cache Creek after the rains have ceased. The third diagram covers the same period and shows the rainfall reported to the U. S. Weather Bureau by the observer at Woodland, and represents fairly the precipitation on the agricultural lands of Cache Creek Basin.

A study of the third diagram shows that in 1897 the rain practically ceased in Cache Creek Basin before the 1st of April and did not begin again until some time in November, a period of seven months; that in 1891, 1892, 1893, 1895, and 1896 the rain ceased in May; that in the remaining three years, 1894, 1898, and 1899, the dry season began by the close of June. It should be further noted that for three of these years there was no rain that could benefit crops for five months, for another no rain for four months, for two years no rain for three months, and for three others no rain for two months.

A study of the last diagram, in connection with the first and second, suggests that a remedy for the shortage of water in the Cache Creek Valley lies in the utilization of the reservoir possibilities of Clear Lake. Here is a great natural reservoir, receiving the precipitation from 500 square miles, and all that is needed to put it into use is the defining and protecting of the rights to the waters of Cache Creek, the rights of the riparian owners on Clear Lake, and the regulation of the flow of the water from the lake.

POWER POSSIBILITIES OF CACHE CREEK.

After leaving Lower Lake there is no irrigable land until Capay Valley is reached. On this part of the stream we have conditions peculiarly favorable for the development of power. This is especially the case below the junction with the North Fork. This branch and the other streams entering below the lake would furnish a good volume during the rainy season even if the waters of the lake and all that could be stored in other reservoirs should be cut off. When these streams fail the accumulated waters would be needed below for irrigation, and storage would thus augment the flow available for power purposes. We have here what too often is impossible to secure, a harmony of interest between the power used and the irrigator.

Farther down the stream leaves Capay Valley proper and makes a detour behind a spur of the mountains, passing through a deep gorge. It reappears in the valley about 3 miles above the town of Capay. At this gorge and in the vicinity of Capay conditions are favorable for the further development of power without serious interference with the use of the water for irrigation.

SOIL.

Capay Valley is about 20 miles long and has a width varying from 1 to 4 miles. The land is not of uniform quality. About one-third of the area is a rich, sandy loam made up of the finer sediment washed in from the hills. This is very fine fruit and alfalfa land, and being sheltered from winds and late frosts this region is pecul-

PLATE XIV.

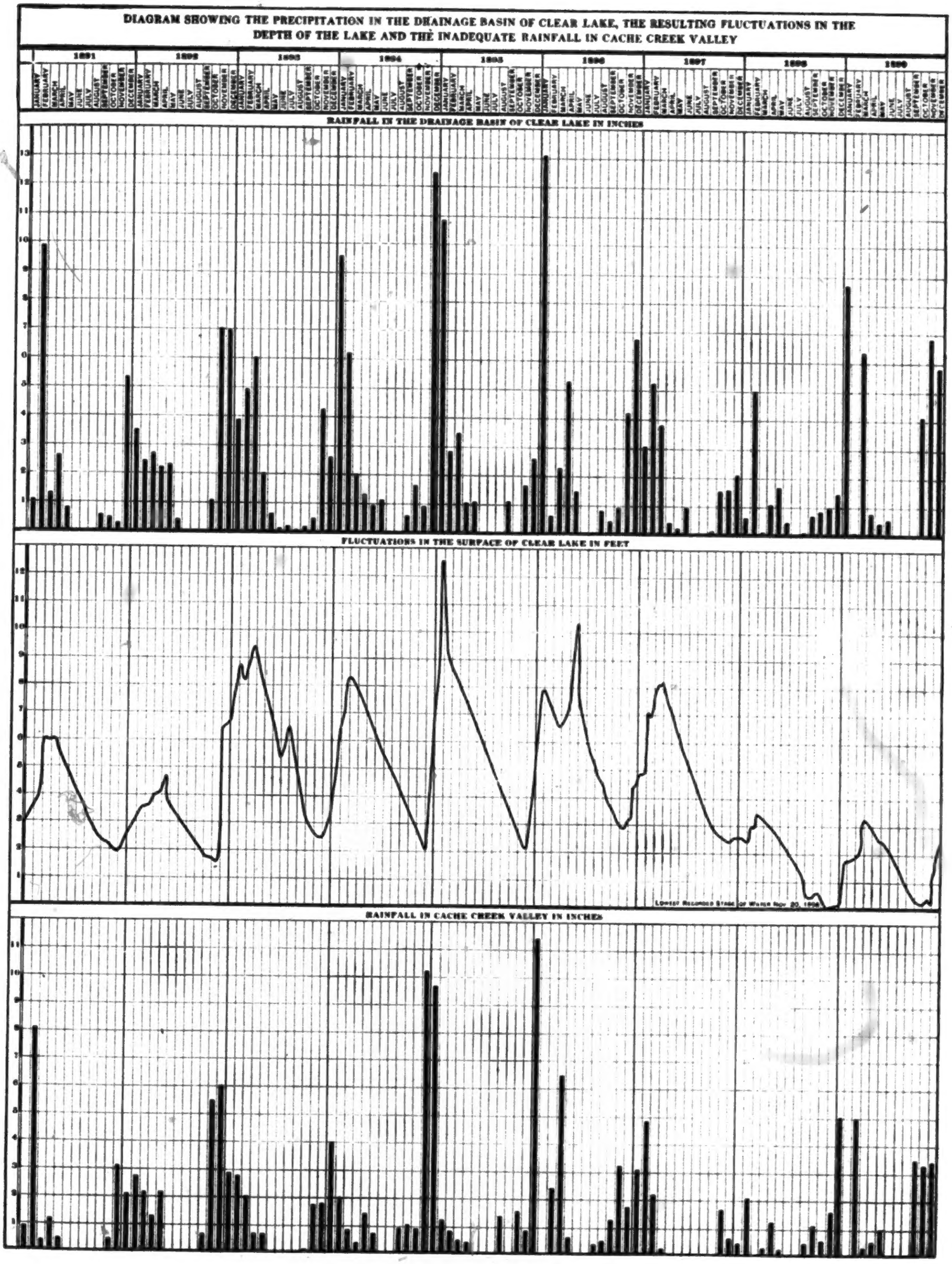


DIAGRAM SHOWING THE PRECIPITATION IN THE DRAINAGE BASIN OF CLEAR LAKE, THE RESULTING FLUCTUATIONS IN THE DEPTH OF THE LAKE AND THE INADEQUATE RAINFALL IN CACHE CREEK VALLEY

iarly fitted for the production of early fruits and vegetables. About one-half of the area of this valley is a stiff clay or adobe. This is more difficult to work, and under irrigation requires drainage and the exercise of care and judgment in the use of water to get the best results. At present, except at the upper end of the valley, where a good deal of fruit is produced, most of the valley and the smoother hill slopes are given over to wheat. The valley being narrow, water used for irrigation can not be taken far from the stream, and a large part of the water diverted must return in the form of seepage. This would be especially true of the water used in winter irrigation, which would return gradually during the following summer. It is a common experience in other localities that the use of water in the upper reaches of a valley like the Capay results after a little time in an increase of the summer flow of the stream below. It takes a little time to establish the new régime, but there is no doubt that a liberal use of water in the winter and early spring in Capay Valley will improve Cache Creek as an irrigating stream.

Cache Creek in times of flood brings large quantities of sediment from the hills. Since the country has been settled and the hills pastured the volume of such material brought down is much increased. Some of it is deposited in the upper valley, and much of the best fruit and alfalfa land of this section is built up of this deposit, but the larger part of this material is carried out into the lower valley, where, because of the change of grade and consequent slower velocity of the stream, it is dropped. The bed of the stream is gradually being filled up with this wash. The coarser material is deposited where the grade first flattens, and the lighter sediment is carried on below. The gravel beds in which the stream sinks near Capay are the accumulations of the coarser material. During floods, when the river gets outside its banks, the suspended material is deposited on the submerged lands nearest the stream. The creek has thus built up along its banks a ridge of this sedimentary matter. The material transported when the stream does not escape from its banks and such as is carried in the main current in the greater floods is deposited on the west side of the great Sacramento Slough. There is a strip of this material several miles wide extending from above Blacks Station, in the northern part of Yolo County, to Putah Creek, in the southern part, a distance of about 18 miles. The average width of this strip is about 6 miles. The location and extent of this deposit is shown on the map (Pl. XI, p. 156). There is no finer agricultural soil than this sedimentary deposit. It is mellow, warm, and fertile, with good drainage, yet holding a reserve of moisture to resist drought. It is ideal grain, alfalfa, and fruit land. You may find growing on this soil wheat, barley, oats, corn, alfalfa, all the vegetables of a temperate and subtropical climate, apples, apricots, nectarines, plums, pears, prunes, oranges, lemons, limes, figs, pomegranates, grapes (table, wine, and raisin), olives, almonds, English walnuts, berries of all kinds, and melons. Some of these lands are better adapted to particular crops than others, yet I venture to say that there are 80-acre tracts of this sedimentary soil in this valley on which everything that has been named is now produced, and I am not sure but that within a single block in the town of Woodland most of these fruits and vegetables can be found growing. There is of this choice land in Yolo County approximately 50,000 acres in one body which may fairly be considered as Cache Creek's contribution to this deposit, and perhaps 20,000 acres of the same character lying to the north and along Putah Creek. This estimate does not include any of the Putah Creek deposits south of that creek, as my investigations did not extend southward beyond the limits of Yolo County.

The low hills to the north of Cache Creek and the lands of Hungry Hollow lying between them and the creek are largely an adobe soil. They are fertile, but require care in working at the proper stage of moisture to secure the best results. It is good grain land, and with irrigation alfalfa and other forage and many kinds of fruit and vegetables could be produced with profit.

The land lying to the south of Cache Creek, between Madison on the north and Winters on the south, and between the mountains on the west and the sedimentary lands before described, is a mingling of red, black, and gray adobe. The red and black adobe are good soils and with proper handling produce good crops. The gray or white adobe is not so good, but with favorable seasons will produce fair crops of grain. In some places this soil is strongly impregnated with alkali salts, and these are the least valuable lands. The mountains which lie to the west are of sandstone formation, and, being steep, the streams which flow down from them bring, during the rainy season, much light sandy material, which is deposited after the streams reach the open country. Where the streams drain large areas and carry much water, as in the Chicahominy and Buckeye sloughs, this sediment is pushed well out into the valley. In some places this deposit is quite deep and covers considerable areas. With irrigation this light soil is very productive, but without artificial watering it will not retain enough moisture to mature crops in dry seasons. Where this material is deposited in moderate quantities it is just what is needed to correct the tendency in the adobe land to run together and bake. Much might be done toward controlling and directing these deposits over this adobe land with great advantage to the crops produced.

The adobe lands of this southwestern part of Yolo County are inclined to be cold, and impenetrable to air and moisture. They need drainage, sand, and humus. The use of water on these lands without providing for drainage would probably be of little benefit, if not disastrous. With a good system of drainage and an intelligent and systematic distribution of the wash from the hills, and of the burden of fine sand and earth carried in the winter waters of Cache Creek, the soil would be rendered friable and warm and correspondingly more productive. The lack of humus could be supplied by the plowing under of green crops and the growing of alfalfa. With systematic and thorough treatment along the lines suggested it is believed that much of this large body of land could be brought to a high state of productivity. The first essential, however, in any successful treatment of these lands is drainage, and any attempt that neglects this is likely to result in disappointment.

The lands lying between the sedimentary deposit and Sacramento River are low and wet. This is a part of the great stretch of swamp land extending from Glenn County southward through Colusa, Yolo, and Solano counties, parallel with Sacramento River, to Suisun Bay. In times of high water this territory is for the most part submerged. It takes the drainage from the watersheds of all the counties named, and from Lake County and a large part of Napa County. It also receives large contributions from Sacramento River when it is in flood. In fact, the waters of the Sacramento are systematically discharged over this swamp land whenever the river threatens the dikes of the reclamation districts. Some attempt has been made to facilitate the discharge of this water by a canal through the lower part of this tract connecting southward with the bay, but the capacity of the canal as constructed is entirely inadequate for the volume to be discharged, and when the floods come the lands remain under water much longer than is good for them or convenient for those who occupy them. While it is not probable that the water can be prevented from covering a large area of this territory when the Sacramento is in flood, if this canal were deepened and widened there is a great deal of rich land that is now of little value that could be brought into productive use.

WHEAT GROWING.

The leading agricultural industry of this section is the production of wheat and barley. The wheat and barley are sown during the fall and winter and grow during the cool months of winter and spring. There is usually rainfall sufficient to mature them. Without irrigation these are practically the only field crops that can be matured. The land has been so long cropped with these grains that the grain-producing elements of the soil are showing signs of exhaustion and the yield has seriously diminished.

When prices are favorable there is something very taking about the methods of the wheat growers of this region. Gang plows drawn by teams of eight or ten horses turn the soil. The man with the harrow rides behind on horseback while directing his team. The seeding is done in the same large way. The harvester, drawn by 32 horses or a traction engine, cuts and thrashes and delivers in sacks each day the grain from 20 to 30 acres. The straw is burned. In the spring succeeding the harvest the land is plowed and then lies fallow until the following fall, when it is again seeded. But without irrigation there can be no rotation of crops and no chance for the soil to recuperate. It is a fascinating but destructive system of agriculture, and the farmers of Yolo County are paying the penalty in steadily diminishing crops. Where once the returns were 40 to 60 bushels to the acre, the farmer now receives 12 to 30 bushels. This, with the low prices prevailing, has rendered grain farming very unprofitable. Only those who by operating on a large scale secure the full advantage of labor-saving machinery can now make wheat farming profitable. The tendency of all this is to the elimination of the small farmer and an increase in the acreage of the larger landholders.

I would not wish to be understood as advocating the abandonment of grain growing in this section. The natural conditions are here peculiarly favorable for the production of wheat and barley, and their cultivation will always be a leading industry, not only in Yolo County, but throughout the whole Sacramento Valley. What I deprecate is the wasteful and destructive system which is impoverishing the land and ruining the farmer. With the rotation of crops, which irrigation would make possible, these lands might soon be restored to their former fertility. A less area in wheat with a larger production would mean success where now is failure.

The small farmer is falling behind, and his lands are gradually passing into the possession of his more prosperous neighbors or into the hands of the trust companies from whom he has borrowed money to keep up the fight. Many once pleasant homes are now deserted and falling into decay, occupied for a few days during each of the seasons of plowing, sowing, and harvesting, by a Chinese cook who prepares the meals for the men who, living in their blankets, are employed temporarily for this work. There can be no healthful social life under such conditions of isolation as the present system entails.

APPROPRIATION LAWS OF CALIFORNIA.

In 1873 the law of appropriation was placed on the statutes of California. It is familiar and does not need to be reproduced here. The idea of posting a notice in order to fix a right has its origin in the practice of the miner in locating mineral claims. The miner's notice was posted on the tract claimed and described its boundaries. It was a sufficient notice to all comers of what was taken. Another miner could, with this before him, fix the boundaries of another claim without risk of interference. It accomplished the purpose for which it was designed. Some California genius, whose name is lost to fame, conceived the idea that a notice posted at the point of diversion would be just as efficient in fixing and defining a claim for water, and so it passed into the statutes to be copied almost verbatim by nearly every one of the arid States at some stage of their irrigation career. How a notice posted in the tule swamps at the outlet of Clear Lake could be seen and regarded by a citizen of Yolo County, 50 miles away, is not clear. The statute imposed no restrictions as to the volume that might be appropriated by a single claimant, and as a result, each claimed without regard to his own needs or to the prior uses of others. If the United States Government had permitted or authorized settlers upon its unsurveyed lands to each claim everything within reach of his vision, and had allowed the claimants to settle the boundaries of their respective claims by appeal to the local courts, we should have had the same trouble with the land boundaries that we now have with water rights, except for this, that a dispute between A and B as to the location of their land lines and the manner of its adjustment need not necessarily be of any interest to Z, who lives in another county, while the adjustment of A and B's differences over a water right, either by agreement or by the decree of a court, may mean the practical extinguishment of the other rights to the waters of a stream.

The manner of making a record under the law is equally faulty. Instead of bringing together in one place the record of the filings on the same stream, the filings are distributed in the records of the various counties through which a stream or its tributaries flow. In the case under consideration, the records of the counties of Yolo, Lake, and Colusa were searched before all the filings could be located. In order to show the character of this record, an abstract of the filings on Cache Creek in Yolo and Lake counties is given in the following tables:

Claims to water on Cache Creek on file in recorder's office, Yolo County.

No.	Date of posting notice.	Date of recording notice.	Name of claimants.	Point of diversion.	Purpose of intended appropriation.	Means of diversion.	Amount claimed.
1	June 14, 1859	Not given	J. D. Stephens	South side of creek where western line of Manchester tract crosses creek, or boundary line of his lands and those of Gilling and Arnold.	Irrigation and "such other purposes and uses as I may deem proper."	Dam and ditch or canal 40 feet wide and 4 feet deep, more or less.	A portion of waters of creek.
2	May 29, 1871	May 30, 1871	Clear Lake Waterworks Co.	Not given	Irrigation, motive, and mining, and for supplying cities, towns, and villages; "said use and appropriation to be exercised as circumstances may require."	"Such mode as may be deemed requisite."	First right to Cache Creek and tributaries.
3	June 12, 1871	June 14, 1871	Cacheville Agricultural Ditch Co.	do	Irrigation and power and for supplying towns and villages; "said use and appropriation to be exercised as circumstances may require."	do	"Use of the water in Cache Creek and tributaries."
4	Apr. 1, 1879	Apr. 10, 1879	H. B. Johnson	South side of Cache Creek where Cottonwood Ditch Co. "now takes water from said creek."	For drinking, stock, irrigating, manufacturing, and agricultural purposes.	Dam and canal or ditch 20 feet wide on bottom, 6 feet deep, etc.	10,000 miner's inches, measured under a 4-inch pressure.
5	Not given	May 19, 1879	Capay Ditch Co	A stake driven in Cache Creek at the bulkhead of the Cottonwood Ditch Co., in Cottonwood Township.	Irrigation and stock	Dam and bulkhead and ditch 12 feet wide on bottom, 3 feet deep, etc.	Do.
6	do	June 1, 1899	Yolo Orchard Co	East bank of said creek at a point 245 yards south of county bridge at Cacheville.	Irrigation of Yolo orchard	Pumps and pipe 12 inches in diameter.	200 inches, measured under a 4-inch pressure.
7	do	do	do	South bank of Cache Creek at a point 83 yards west of a point directly opposite to Hayden's barn.	do	do	Do.
8	do	do	do	East bank of Cache Creek at the warehouse of Yolo Orchard Co.	do	do	Do.

Claims to water on Cache Creek on file in recorder's office, Lake County.

No.	Date of posting notice.	Date of recording notice.	Name of claimants.	Point of diversion.	Purpose of intended appropriation.	Means of diversion.	Amount claimed.
1	May 27, 1871	June 2, 1871	Clear Lake Waterworks Co.	Not given	Irrigation, mining, and supplying cities, towns, and villages.	"In such mode as may be deemed requisite."	First right to Cache Creek.
2	Jan. 11, 1878	Jan. 18, 1878	Feather River Water Co.	W. ½ of SE. ¼ sec. 31, T. 13 N., R. 6 W., on right bank of stream.	Irrigation and supplying city of San Francisco with water for manufacturing and domestic purposes.	Flume 6 feet high and 12 feet wide.	20,000 inches, measured under a 4-inch pressure.
3	July 15, 1892	July 20, 1892	J. L. Rathbone et al	Not given	Irrigation and furnishing motive power to generate electricity.	Ditch 30 feet wide on top, 15 feet wide on bottom and 7 feet deep.	40,000 inches, measured under a 4-inch pressure.
4	Sept. 6, 1892	Sept. 6, 1892	A. A. Wheeler	Facing Fowler mill site on west bank of creek on or about lots 2 or 3 in N. ½ sec. 6, T. 12 N., R. 6 W.	Power, irrigation, domestic, stock, agricultural, manufacturing, mechanical, commercial, and transportation.	Dam and canal 20 feet wide on bottom, 40 feet wide on top, and 7 feet deep, with sufficient fall to convey the water claimed.	60,000 inches, measured under a 4-inch pressure.
5	do	do	do	North bank of creek on or about lot 4 in SE. ¼ sec. 34, T. 13 N., R. 7 W.	do	do	Do.
6	do	do	do	North bank of creek on or about lot 4 in NE. ¼ sec. 2, T. 12 N., R. 7 W.	do	do	Do.
7	Nov. 19, 1892	Nov. 28, 1892	F. Formahls	On the left bank of creek at the old dam in sec. 2, T. 12 N., R. 7 W.	do	Dam and canal 30 feet wide on bottom, 7 feet deep, with fall sufficient to carry the water claimed.	40,000 inches, measured under a 4-inch pressure.
8	do	Dec. 5, 1892	H. Bynum	Left bank of creek on or about the Fowler milldam, in sec. 6, T. 12 N., R. 6 W.	do	Dam and ditch 30 feet wide on bottom, 7 feet deep, with fall sufficient to carry the water claimed.	Do.
9	Jan. 18, 1893	Jan. 18, 1893	W. A. Whitney	North bank of creek on or about the Grigsby Riffle, in SE. ¼ of sec. 34, T. 13 N., R. 7 W.	Power, domestic, stock, agricultural, manufacturing, commercial, mechanical, and transportation.	Dam and pipes 4 feet in diameter, with fall sufficient to convey the water claimed.	Do.
10	do	do	do	North and west bank of creek on or about Fowler dam site, in N. ½ sec. 6, T. 12 N., R. 6 W.	do	do	Do.

11	Mar. 16, 1893	Mar. 21, 1893	C. G. Baldwin	Foot of Clear Lake, on land of Jacob Bower.	Irrigation, domestic, or other	Dam and steel pipes	4,460,544,000 cubic feet, besides water for evaporation. Also claims the right to reservoir the water.
12	Apr. 29, 1893	May 8, 1893	J. B. Treadwell	On or about Fowler milldam.	Power, irrigation, domestic, stock, agricultural, mechanical, commercial, and "importation."	Dam and canal 30 feet wide on bottom and 7 feet deep, with fall sufficient to convey the water claimed.	40,000 inches, measured under a 4-inch pressure.
13	do	do	do	Grigsby Riffle	do	do	Do.
14	May 1, 1893	do	C. G. Baldwin	Near Fowler milldam	Domestic, irrigation, and mechanical.	Three 60-inch steel pipes	20,000 miner's inches.
15	June 28, 1893	June 28, 1893	W. P. Miller	Right bank of creek on or about Grigsby Riffle, in sec. 35, T. 13 N., R. 7 W.	Power, irrigation, domestic, stock, agricultural, manufacturing, mechanical, commercial, and transportation.	Dam and canal 30 feet wide on top, 7 feet deep, with fall sufficient to convey the water claimed.	60,000 inches, measured under a 4-inch pressure.
16	do	do	do	Fowler milldam	do	do	Do.
17	Aug. 26, 1893	Sept. 4, 1893	G. P. Ayers	On or about Fowler milldam.	do	do	Do.
18	do	do	do	Grigsby Riffle	do	do	Do.
19	Oct. 24, 1893	Oct. 30, 1893	A. L. Stetson	Fowler milldam	do	do	Do.
20	do	do	do	Grigsby Riffle	do	do	Do.
21	Dec. 15, 1893	Dec. 21, 1893	A. T. Hallidie	Fowler milldam	Power, land, domestic, stock, agricultural, manufacturing, mechanical, and commercial.	do	Do.
22	do	do	do	Grigsby Riffle	do	do	Do.
23	Feb. 12, 1894	Feb. 17, 1894	J. Armstrong	Fowler milldam	do	do	Do.
24	do	do	do	Grigsby Riffle	do	do	Do.
25	Apr. 11, 1894	Apr. 18, 1894	J. C. Reud	Fowler milldam	do	do	Do.
26	do	do	do	Grigsby Riffle	do	do	Do.
27	June 9, 1894	June 14, 1894	J. H. Culver	Fowler milldam	do	do	Do.
28	do	do	do	Grigsby Riffle	do	do	Do.
29	Aug. 6, 1894	Aug. 8, 1894	F. X. Simon	Fowler milldam	do	do	Do.
30	do	do	do	Grigsby Riffle	do	do	Do.
31	Oct. 3, 1894	Oct. 11, 1894	G. King	Fowler milldam	do	do	Do.
32	do	do	do	Grigsby Riffle	do	do	Do.
33	——, —, 1894	Dec. 7, 1894	Henry Ernst	Fowler milldam	do	do	Do.
34	——, —, 1894	do	do	Grigsby Riffle	do	do	Do.
35	Jan. 28, 1895	Feb. 4, 1895	O. Lewis	Fowler milldam	do	do	Do.
36	do	do	do	Grigsby Riffle	do	do	Do.
37	Mar. 28, 1895	Apr. 6, 1895	J. Schroder	Fowler milldam	do	do	Do.

Claims to water on Cache Creek on file in recorder's office, Lake County—Continued.

No.	Date of posting notice.	Date of recording notice.	Name of claimants.	Point of diversion.	Purpose of intended appropriation.	Means of diversion.	Amount claimed.
38	Mar. 28, 1895	Apr. 6, 1895	J. Schroder	Grigsby Riffle	Power, land, domestic, stock, agricultural, manufacturing, mechanical, and commercial.	Dam and canal 30 feet wide on top, 7 feet deep, with fall sufficient to convey the water claimed.	60,000 inches, measured under a 4-inch pressure.
39	May 27, 1895	June 5, 1895	J. C. Sala	Fowler milldam	do	do	Do.
40	do	do	do	Grigsby Riffle	do	do	Do.
41	July 25, 1895	July 25, 1895	W. M. Fitzhugh	On right bank of creek, 50 feet below Fowler milldam.	Agricultural, mining, and power	Ditch with grade of 8 or 15 feet per mile.	600 cubic feet per second.
42	July 26, 1895	Aug. 5, 1895	C. McCurdy	Fowler milldam	Land, domestic, stock, agricultural, manufacturing, mechanical, and commercial.	Dam and ditch, 30 feet wide on top, 7 feet deep, with fall sufficient to convey the water claimed.	60,000 inches measured under a 4-inch pressure.
43	do	do	do	Grigsby Riffle	do	do	Do.
44	Sept. 20, 1895	Sept. 28, 1895	E. P. Clendenen	Where Cache Creek intersects north line of sec. 31, T. 13 N., R. 6 W., and again where said creek is intersected by North Fork of Cache Creek; and again at Rumsey.	Irrigation and power	Canal 15 feet wide on bottom, 30 feet wide on top, and 7 feet deep.	100,000 cubic inches per second measured under a 4-inch pressure.
45	Nov. 19, 1895	Nov. 27, 1895	J. K. Fraser	At or near sec. 32, T. 13 N., R. 6 W., and where Cache Creek is intersected by North Fork of Cache Creek; and at Rumsey.	Power and irrigation	Dams, ditches, canals, flumes, and pipes. Ditches 15 feet wide on bottom, 30 feet wide on top, and 7 feet deep.	500,000 cubic inches measured under a 4-inch pressure.
46	Jan. 23, 1896	Jan. 25, 1896	do	do	do	do	Do.
47	Mar. 14, 1896	Mar. 26, 1896	E. P. Clendenen	About 100 yards southeast of where Cache Creek leaves Clear Lake.	do	do	1,000,000 cubic inches measured under a 4-inch pressure.
48	May 23, 1896	June 1, 1896	J. A. Margo	Fowler milldam	Land, domestic, stock, agricultural, manufacturing, mechanical, and commercial.	Dam and ditch 30 feet wide on top, 15 feet wide on the bottom, with fall sufficient to convey the water claimed.	60,000 inches measured under a 4-inch pressure.
49	do	do	do	Grigsby Riffle	do	do	Do.

50	Aug. 19, 1896	Aug. 22, 1896	E. P. Clendenen	In sec. 23, T. 13 N., R. 7 W., on the north side of creek at the junction of the two outlets of Clear Lake.	Power and irrigation	Dam, ditches, canals, flumes, and pipes. Ditches to be 15 feet wide on bottom, 30 feet wide on top, and 7 feet deep.	1,000,000 inches per second measured under a 4-inch pressure.
51	Oct. 21, 1896	Oct. 30, 1896	do	do	do	do	Do.
52	Dec. 21, 1896	Dec. 24, 1896	do	do	do	do	Do.
53	May 24, 1897	May 26, 1897	do	do	do	do	Do.
54	Mar. 2, 1898	Mar. 2, 1898	do	do	do	do	Do.
55	Feb. 20, 1899	Feb. 20, 1899	C. R. Corning	In sec. 6, T. 12 N., R. 6 W., at the entrance to the outlet channel of Clear Lake.	Power to generate electricity, surplus for irrigation, stock, domestic, agricultural, manufacturing, mechanical, and commercial.	Dam and flume 10 feet wide and 6 feet high, with fall sufficient to convey the water claimed.	20,000 inches measured under a 4-inch pressure.

These tables do not include any of the filings on the tributaries. After the filings are found in the records there is no means of determining which of the claims have been perfected by the construction of works and the use of water. They all appear on the record as of equal force. The only way to determine definitely which of the appropriations have been used is by a careful survey and inspection of the stream and each of its tributaries from which water is claimed from their sources to where Cache Creek loses itself in Sacramento Slough. In so doing we discover that most of the claims ended with the posting and filing. Only three of the claimants ever attempted to construct works, and only those of the Yolo orchard are now in use. Of the recorded claims to the waters of Cache Creek, in Lake County, not one advanced beyond the stage of filing. There is a curious sameness of thought and language in the filings at Grigsby Riffle and Fowler Mill, which would indicate that it was the same moving spirit that brought about all these filings, and that the sole purpose was to shut out and deter any who might, in good faith, seek to appropriate.

On the other hand, we find many appropriations of which there is no record. The appropriators have never made filings and have been fortunate enough or insignificant enough to keep out of court. The California courts have held that the failure to file a claim does not in any way impair the right, except that the appropriation dates from the beginning of the work instead of from the date of posting notice. The extent of these unrecorded appropriations can be determined only by careful survey of the lands irrigated and an inspection of the works used for diversion. There are 64 recorded claims for water from Cache Creek. Forty-six of these are for water delivered under a 4-inch pressure. The total aggregate of these 46 claims is 2,230,000 inches. One claims 20,000 miner's inches; another, 600 cubic feet per second; a third, 5,000,000 inches per second. Four other claims are for cubic inches of water used under a 4-inch pressure. The aggregate of these four claims is 2,100,000 of the kind of unit described, whatever that may mean. Another wants 4,460,544,000 cubic feet and water for evaporation. Not counting the 2,100,000 cubic inches under a 4-inch pressure and the "4,460,544,000 cubic feet and water for evaporation," there remains an aggregate of 7,380,000 inches, equal to 147,600 cubic feet per second. For all this array of filings and figures there is in operation under these claims one lone pumping plant using 8 cubic feet per second. As against the one party with the regular filing, who uses water from Cache Creek, there are thirteen persons using water without filing. The fact that they are below the Moore Ditch and content themselves with what escapes diversion at the dam has thus far enabled them to avoid trouble. Under the present system it is only a question of time when controversy will arise and all these rights will have to get into court. Trouble is inevitable.

Want of space forbids the publishing of the abstract of filings on the tributaries of Cache Creek and Clear Lake. They are of the same general character as those on Cache Creek and many of them equally absurd. It is sufficient to say that out of 49 claims on record 5 are in use on areas ranging from 2 to 30 acres. Double this number are using the water without filing. The records in these counties are not exceptional. In every county in California which I have had occasion to investigate and in every other State where this system of posting and filing prevails, the same conditions hold. Anything more ineffectual and misleading than such a record would be difficult to conceive.

The supply of water in most of the Lake County streams at the season when irrigation is needed is precarious, and the areas irrigated are small. Scotts Creek is an exception. Here the flow, though not large, is more constant, and irrigation is possible at times when it is most needed. There are also several artesian wells in this valley, and small areas are irrigated from this supply. Unless storage facilities can be secured on the upper reaches of the mountain streams, the area irrigated in this county is not likely to be greatly enlarged. Even with storage, the amount of water that can be utilized in this region is small compared with the whole supply in Clear Lake and Cache Creek, and there can be no controversy with the users below. What the opportunities for such storage may be I had no opportunity to investigate.

IRRIGATION FROM CACHE CREEK.

The first irrigation from Cache Creek was undertaken by James Moore in 1856. Before beginning work on his canal Moore purchased 850 acres of land covering the point of diversion from William Gordon, also the right of way for the ditch through the Gordon grant. Gordon delivered to Moore a bond for a deed for 850 acres of the Gordon grant, "together with the entire and exclusive right to build and erect and keep in repair a dam across Cache Creek * * * and the entire and exclusive right to use the waters of the aforesaid 'Jesus Maria' or Cache Creek running through said Gordon's grant, to the sole use and behoof of the said James Moore, his heirs and assigns forever." A deed was later executed, in accordance with the terms of the bond, to F. W. Fratt, Moore's assignee, and the property was by him afterwards deeded to Moore.

This transfer has an important bearing on the subsequent history of Yolo County and is worthy of some attention.

In this bond Gordon assumes to fix the title to the water of Cache Creek in Moore. In order to find the ground for Gordon's assumed right to deed away Cache Creek I have made a careful examination of all the papers on file bearing Gordon's title. Gordon's deed came direct from the Mexican governor, General Micheltorena. It reads as follows:

> Manuel Micheltorena, governor, commanding general, inspector of the department of both Californias:
>
> Whereas William Gordon, a naturalized Mexican, has made application, for his personal benefit and that of his family, for a tract of land in Sanoma between Sierra of Napa and the river Sacramento, the steps and inquiries concerning it being previously made, according to the provisions of the laws and regulations, using the authority which is conferred upon me, in the name of the Mexican nation, I have conceded to him a part of the land mentioned, declaring to him the ownership of it by these presents letters subjecting it to the approbation of the most excellent departmental assembly, and under the following conditions:
>
> (1) He may inclose it without prejudice to crossings, roads, and servitudes; he may enjoy it freely and exclusively, appropriating it to the use which best suits him, but within a year he shall build a house and it shall be inhabited.
>
> (2) When the ownership of it shall be confirmed to him, he shall solicit the proper judge that he may give him judicial possession in virtue of this title; by whom the boundaries shall be marked out, in the limits of which he shall place corner posts and some fruit or forest trees of some use.
>
> (3) The land of which mention is made is of 2 square leagues within the bounds as represented by the map which is annexed to the respective expedient. The judge who shall give the possession

shall cause it to be measured conformably to the ordinance, leaving the overplus to the nation for proper uses.

If he contravenes these conditions he shall lose his right to the land and it shall be denounceable by another.

Wherefore I order that, this present title being held as firm and valid, entry be made of it in the book to which it belongs, and it is to be delivered to the interested person for his security and other ends.

Given in the city of Los Angeles on the 27th of January, 1843.

MAN'L MICHELTORENA.

MAN'S ISIRENO, *Secretary*.

(Translation certified by George Fisher, secretary.)

When we remember that the Mexican Government has never at any time in its history recognized the doctrine of exclusive riparian ownership in water, and has always insisted on the right of citizens and communities to appropriate water for beneficial use under proper regulations, the presumption involved in the making and accepting of the Gordon-Moore deed is stupendous.

In 1860, after the necessary steps had been taken toward quieting title to these Mexican grants, the United States Government issued a patent for the Gordon grant. This patent, after reciting the necessary land descriptions, confirms the grant to Gordon in terms as follows:

> Know ye: That the United States of America, in consideration of the premises and pursuant to the provisions of the act of Congress aforesaid of March 3, 1851, have given and granted, and by these presents give and grant unto William Gordon, and to his heirs, the tract of land embraced and described in the foregoing survey, but with the stipulation, that in virtue of the fifteenth section of said act the confirmation of this said claim and this patent "shall not affect the interests of third persons." To have and to hold the said tract with the appurtenances unto the said William Gordon and to his heirs and assigns forever with the stipulation aforesaid.
>
> In testimony whereof, etc.
>
> By the President:
>
> JAMES BUCHANAN.
>
> WASHINGTON, *February 4, 1860*.

What exclusive rights this patent or the Mexican deed conveyed is not apparent.

Moore also bought from one Thomas Harbin, at that time the principal owner of the Hardy grant, 200 acres of land lying along Cache Creek and the right of way for his ditch across a portion of Harbin's other lands. The clause of Harbin's deed to Moore referring to the right of way was later made the basis of a claim on the part of Moore that he had purchased all riparian rights on Cache Creek below the head of his ditch; and, as it will be necessary to refer to this later, the clause is here quoted:

> And the said party of the first part (Harbin) for the consideration aforesaid further grants, bargains, and sells and aliens and conveys unto the said party of the second part (Moore), his heirs and assigns forever, the right, title, and privilege of bringing water to the said tract or parcel of land (the 200 acres purchased) by means of a canal or ditch from Cache Creek over and across any lands or real estate owned, sold, or claimed by said party of the first part, and situated between the tract or parcel of land and real estate aforesaid, and a certain other tract or parcel of land claimed and owned by said party of the second part under an agreement of purchase from one William Gordon.

This on its face is a deed to right of way across the Harbin lands lying between the tract purchased from Gordon and the tract conveyed in the preceding clauses of this deed. But the wording is ambiguous, and it may be that Harbin intended to give a right to water for 200 acres which should take precedence over the rights attaching to his other riparian lands. Beyond this there is nothing in the deed to indicate that Harbin understood that he was transferring the right to water lands not riparian or that can reasonably be considered as alienating all riparian rights from Harbin's other lands lying along Cache Creek.

From this time forward Moore claimed exclusive ownership in the waters of Cache Creek and held himself in readiness to defend it against all comers.

In 1856 work was begun. A temporary dam of brush and gravel was made, and the headgate and a short section of the ditch was constructed of capacity sufficient to carry a considerable volume of water. The ditch was extended some 3½ miles to some lands owned by Moore, but the canal, except for a part of the first mile, was much reduced in size. Only a small tract was watered. In the voluminous testimony concerning the ditch evidence as to the actual use of the water is conspicuously absent, but, as nearly as can be determined from the conflicting evidence given in the various suits over this claim, the volume actually diverted and used prior to 1864 never exceeded 2.5 cubic feet per second. In 1864 the ditch was enlarged and extended and the grade of the section at the head changed to secure greater capacity. The ditch was also extended in two branches—one toward Woodland, the other southward. The total length of the canal and main branches at the close of this work in 1864 was about 9 miles.

The Moore Ditch of to-day has substantially the same extent as in 1864. Extensions and laterals have been built by the users of the water, but these are owned and maintained by the parties who have constructed them. Some of these extensions are made by individuals, others by organized companies of farmers. The most important of these organizations are the South Fork Water Ditch Company and the Farmers Irrigating Ditch Company. The ditch of the first-named company was built in 1864 and has a capacity of about 40 cubic feet per second. It covers about 2,000 acres of fine lands, but now irrigates only about 1,000 acres. The original cost of this ditch was about $2,400, mostly in labor. The Farmers Irrigating Ditch Company also built its canal in 1864, which has a capacity of about 20 cubic feet per second. It covers about 1,000 acres and cost originally about $1,500. The total length of the Moore Ditch and the extensions and laterals is estimated at about 70 miles, but this probably includes some of the smaller field laterals. There are approximately 30,000 acres of fine land that could be watered from this ditch and its extensions if the ditch could supply the water.

The ditch was operated for many years with temporary dams, which were usually carried out during the winter rains. In 1881 a more permanent dam was put in. This remained until 1886 when, owing to defective construction or neglect of repairs, it was washed out. Since the dam went out it has been replaced each year by a temporary structure of brush and gravel, which disappears with the first heavy rains and can not be replaced in the spring until all danger of flood is passed. Once or twice, when the owners of the land have been especially desirous of obtaining water, they have secured the building of the dam a little earlier in the season by giving bond for the cost of the dam in case it should be washed out. The water users feel that this is a one-sided arrangement and generally await the action of the ditch owners. One of the views in Plate XV shows the character of the construction of the dam for the present season. As it is not expected to withstand floods, it is, of course, made as slight and inexpensive as possible. This operates to prevent the use of the water in the season when it is abundant and when its use on orchards, vineyards, and alfalfa would be most beneficial. During the cool weather, when the trees and vines are dormant, it is possible to water much more thoroughly and to greater depths than is safe in the heat of summer. The water applied at this time reaches the deeper roots and, stored in the subsoil, furnishes a reserve of moisture for summer supply. Under such conditions much less water and shorter irrigating periods suffice for keeping everything in full vigor during the growing and fruiting season. In winter the low temperature is also less favorable for evaporation, and hurtful salts are much less likely to be brought to the surface than in summer. The applying of water during the hot season, especially if the earth is dry to a great depth and the application long continued, is always attended with risk of baking the soil and scalding the growing crops, and it is desirable that the irrigating periods of this season be as infrequent and as short as possible while furnishing the necessary moisture for vigorous and healthy plant growth. Another advantage of winter irrigation is that the lands may thus be cleared of gophers. In places where water is near the surface, say at depths of 5 to 8 feet, with a favorable season for seeding, alfalfa will grow, and after the first season would thrive without irrigation were it not for these animals. These burrow in the alfalfa fields and feed on the roots. If allowed to have their way they, in a few years, kill out the alfalfa. When the fields are flooded with cold water in winter the gopher is either drowned, or driven out, chilled and drenched, to perish in the cold. When driven out by summer irrigation he makes his way to the nearest bank and waits for the sun to dry his coat and for the water to recede. He is soon no worse for his bath, and the irrigated land is the better fitted for his operations. When land is regularly watered in winter there is practically no trouble with this pest. But without this the gopher has undisputed possession and soon makes reseeding necessary. The consequent loss and expense deters many from the cultivation of this crop. Wherever winter irrigation has been practiced in this region the results have been approved.

The Moore Ditch has not been cleared out or adequately repaired for many years, and is choked with moss and other vegetable growth to such an extent that its capacity is very much reduced. Plate XV shows its present condition.

For the purpose of finding the character of the service rendered, a series of questions was sent to each person who was supposed to be using water under this ditch. The information thus gathered shows that the water is not received at the time and in the volume needed to secure the best results. Out of forty-seven persons replying to the questions: "Have you had water from the ditch to the amount needed and at the time needed?" forty-three answered "No," and four answered "Yes." And in response to the request, "State the length of time you waited after you needed or asked for the water," forty-six of the forty-seven gave answers as follows:

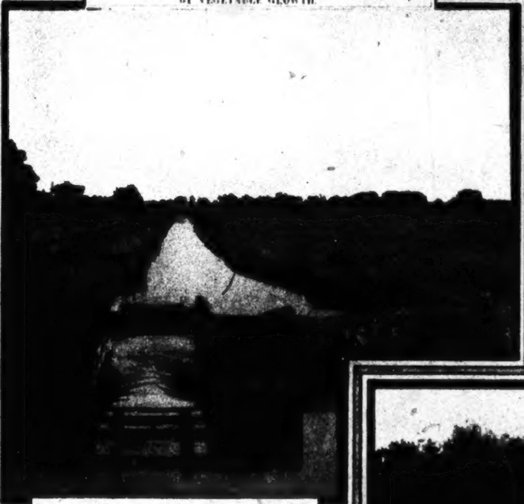
"Had all the water wanted at all times," "A few hours," "Did not have to wait long in 1900," "Ten days," "Fourteen days," "Sometimes have to wait," "Sometimes as long as two weeks," "Fifteen days," "One to three weeks," "Twenty days," "About three weeks after it was needed," "Three weeks," "One week to one month," "Two to four weeks," "About three weeks," "Sometimes we have to wait three to four weeks," "Three to four weeks," "Always have to wait in August and September,"

VIEWS ALONG MOORE DITCH

LO COUNTY,
CALIFORNIA.

SHOWING HOW CAPACITY OF DITCH IS REDUCED BY VEGETABLE GLOWTH.

A NEGLECTED DITCH.



GIBSON LATERAL AND MEASURING BOX.

A SECTION OF DITCH.

BRUSH AND GRAVEL DAM IN CACHE CREEK. HEAD OF DITCH.

HEADGATE OF DITCH.

"The brush dam was put in late and everybody wanted the water before it was ready," "Three to four weeks," "About four weeks," "Four weeks," "Thirty days," "Sometimes wait a month or more," "About one month," "One month," "From April until June," "One to five weeks," "Thirty to forty days," "Anywhere from one to six weeks," "Six weeks," "Six weeks," "Three to six weeks," "Four to six weeks," "Five to six weeks," "One and one-half months," "One to eight weeks," "One to three months," "One to six months," "Long enough to lose one crop of alfalfa each year," "Got none," "There is no regularity about it," "We wait until the water happens to come our way and take what we can get," "Are still waiting, and are liable to," "This year my crop was half grown when I got water," "Have not had a thorough or satisfactory irrigation for three years," "We are unable to get a supply of water at any time."

If this failure to supply water was confined to August and September, when there is little water in the stream, it might be excused, but it is not. On June 30, when the ditch was taking 60.52 cubic feet per second, 75.88 cubic feet per second was passing the headgate down Cache Creek. The larger part of this was wasted in the swamp. This was at a time when water was much needed and the demand much in excess of the volume which could be supplied by the ditch. As this ditch is managed, water can not be used except in the season when the supply and the capacity of the ditch is least and the demand for the water greatest.

Surprising as is the condition of affairs set forth in the answers of the water users, one does not have to look far for the cause. If water is private property, the canal owner may do what he will with his own, and he may serve or neglect his customers as suits his convenience or inclination. The only thing that can change the situation and reform this service is the recognition of the broader principle, which sooner or later must apply in every arid country, that water is public property and the ditch owner a public servant, and that the right to take water from a stream carries with it the obligation of impartial and adequate service to the water users. The extent of the right must be the measure of the obligation.

If the taking of water from a stream and the protection of the rights already vested is not a matter of public interest, it follows that each appropriator must protect his own interests, and the litigation must go on in an ever-increasing ratio. So long as the rights of the owners of the Moore Ditch are neither defined nor protected, so long must they be in conflict with every new appropriator. They can not evade the contest. These people are not more contentious than others. The elder Moore was an enterprising, public-spirited man. His successors are good neighbors and respected citizens. The chief responsibility for the present deplorable situation does not rest with the canal owners. They, along with the people of the valley, are the victims of a bad system, founded on the false principle of private ownership of water.

Acting under the statute of California the board of supervisors of Yolo County have attempted to fix the rates to be charged and the method of measurement under the Moore Ditch. The ordinance reads as follows:

> The board of supervisors of the county of Yolo, State of California, do ordain as follows:
>
> SECTION 1. The maximum rate at which the owners of the Moore or Woodland Ditch shall sell and distribute for irrigation purposes the water appropriated by such owners and distributed by means of such ditch is hereby fixed at the sum of $4 per foot for the period of twenty-four hours, with the water flowing at the rate of 2 feet per second.

SEC. 2. The measurement of said water shall be made at the bulkhead in said ditch nearest to the place of actual use; provided, that where water is furnished through branch ditches not owned by the owners of said Moore Ditch, the measurment shall be at the bulkhead connecting the branch ditch with the said Moore Ditch. The measurements shall be made from the top of a weir four inches high, constructed in the bottom of the bulkheads where measurement is made, and over which weirs such water must flow.

SEC. 3. The patrons of said Moore Ditch shall be permitted to permanently fix in and affix to the bulkheads, where measurement is made, graduated scales, marked off into feet and inches, by means of which the depth of water flowing over the weirs therein can be detected at a glance.

The attempt to fix a unit of measurement is unfortunate. If the bulkhead or flume in the head of the branch ditch and the branch below the weir could be so arranged that the water would always pass at the rate of 2 feet per second, the unit "foot" prescribed in the first paragraph might be interpreted to mean 2 cubic feet per second, but how, with the varying heads in the main ditch and the differences in the grades of the branch ditches, this velocity of 2 feet per second is to be maintained is not clear. The weir prescribed in the second paragraph adds to the complication. If a branch ditch has fall enough and capacity enough below the weir to give a free escape of the water from the bulkhead, the velocity increases with the depth on the weir and this depth varies with the head in the ditch. If the grade of the branch ditch below its headgate is light, the water escapes slowly, and the velocity over the weir is retarded. Under what set of conditions any given ditch would receive the water at the velocity of 2 feet per second could be ascertained only by a series of velocity measurements. I could not find that these had been made. The ordinance does not secure either regularity in the volume delivered or uniformity in the price paid for water, and these irregularities are the cause of much complaint on the part of the water users.

HISTORY OF OTHER ATTEMPTED APPROPRIATIONS AND CONSEQUENT LITIGATION.

In 1859 a number of farmers in the vicinity of Cacheville, now Yolo, organized the Cacheville Agricultural Ditch Company and built a ditch for the watering of their own land. The ditch has its headgate on the north side of the stream at a point about 5 miles above the town and a short distance below the Moore Dam. It extended to a point about 1 mile below Cacheville and covered several thousand acres on the north side of the creek. Some of the stockholders had holdings on the south side, and the water was carried across the creek to these lands in an iron pipe 4 feet in diameter and about 200 feet long. Their dam was of gravel and was replaced each year. An elaborate system of laterals was constructed and the land prepared for irrigation at heavy expense. This ditch was built and in operation as early as the spring of 1860. It is estimated that the total expense of all the work was about $75,000. As before stated, the Moore Ditch, later known as the Woodland Ditch, was enlarged in 1864 and the use of the water extended to new lands. This, when water was low, interfered with the operations of the Cacheville Company and they sought the protection of the district court. In their complaint they asked for an adjudication of rights as between the Woodland and the Cacheville companies, for an assessment of damages against the Woodland Company, and for an injunction restraining the Woodland Company from diverting the water. For answer the defendant sets up the Gordon and Harbin deeds to Moore, claiming under these deeds the exclusive right "to all the waters that did or could run in Cache Creek," as against the Cacheville people who were on the Harbin grant and whose deeds were of later date than Moore's right of way deed from Harbin. It is interesting to look back at the Harbin deed in this connection to see what it really did convey. (See quotation on p. 172.)

The defendant denies the complaint of the plaintiff and avers, among other things—

That in 1856 the defendant had constructed a dam, ditch, and headgate of sufficient capacity to carry all the waters of Cache Creek except when swollen by winter rains;

That in 1863 and 1864 the defendant had cleaned and enlarged this ditch to about the capacity originally intended, and that now his ditch carried no more water than it was originally intended to carry.

November 11, 1871, judgment was rendered in this case in favor of the Cacheville Company. The findings are too long to be quoted here, but the conclusion is as follows:

> As conclusions of the law the court finds:
>
> (1) That the defendant jointly with one F. W. Fratt is first entitled to divert 2.43 cubic feet of the water of Cache Creek per second.
>
> (2) That the plaintiff is next entitled at all times to divert from the said Cache Creek a quantity of water equal to the capacity of its ditch.
>
> (3) That the capacity of the plaintiff's ditch is that quantity of water which would flow through it when for two-thirds of the length of the ditch from its upper end it is of the size of 15 feet in width on the bottom, 4½ feet deep, with a slope at the sides outward from the bottom of 1½ feet to each foot in height and a grade of three-eighths inches to each 100 feet in length, and the remaining third in length of said ditch is of the size of 10 feet in width on the bottom, 5½ feet deep with a slope at the sides outward from the bottom of 1½ feet to each foot in height, and a grade of 1 inch to each 100 feet in length.
>
> (4) That the plaintiff is entitled to a decree perpetually restraining the defendant and all persons claiming or to claim by, through, or under it since the commencement of the action, and its officers, agents, and employees from diverting more than 2.43 cubic feet per second of the water of said creek unless at such times as there may be more water flowing in said creek than would supply the said 2.43 cubic feet per second and fill the plaintiff's ditch to its full capacity, as hereinbefore set out.
>
> (5) That plaintiff is further entitled to a judgment for $10 damages accrued before the commencement of this action, and the costs and disbursements by it in this action.
>
> And it is so ordered.
>
> T. B Riordan,
> *District Judge of the Fourteenth Judicial District,*
> *presiding at the request of, etc.*
>
> Attest:
> W. B. Brown, *Clerk.*

The motion for a new trial was denied. On January 22, 1873, the case was appealed. October 30, 1874, the supreme court of California rendered judgment reversing the findings of the lower courts and remanding the case with instruction to the lower court to render judgment for the Woodland Company, pursuant to the specific prayer of the answer. October 31, 1874, the district judge rendered judgment as ordered, with costs for the defendants $312.65. The Cacheville Agricultural Ditch Company went out of business. The ditch, being useless and an obstruction to cultivation, has been largely obliterated. Thus closes the first chapter in the litigation over the Cache Creek waters.

In 1871 the Clear Lake Water Company began the construction of a dam at the head of the Capay Valley, a short distance above where Rumsey Station now stands. This ditch was not completed and put into use until 1874. Originally it extended some 9 miles down the valley, but was never used beyond Guinda, 6 miles below the point of diversion. Near the head the lands were nearly all watered, but below the use was not general. July 31, 1876, two years after the ditch was completed and used, complaint was filed by the Woodland Ditch Company against the owners of this ditch. Again Moore's title to the waters of Cache Creek, "all of them," as derived from Gordon, was set up. Among other modest affirmations of the complaint are—

> The said ditch, at its full capacity, is capable of carrying about 80,000 cubic feet of water per minute;
>
> That the amount of the waters so diverted by the defendant was 2,000 feet, all of which belonged to the plaintiff by prior appropriation and right of property, and which would have, had it not been so diverted, flowed into the ditch of the plaintiff, and could have been sold at the rate of $4 per foot.

The plaintiff prays for an injunction restraining the defendant from taking any water from the creek belonging to the plaintiff, and asks that the court will determine by its decree the rights of the plaintiff and defendant to the waters of Cache Creek. For answer the defendant denies the allegations of the plaintiff and attacks the legality of the Woodland Ditch Company as a corporation.

The plaintiff was nonsuited and costs taxed at $345.05 were awarded to the defendant.

August 30, 1878, James Moore again appears in his own name with a new complaint. He claims:

> That he is the owner of the right to divert all the waters of Cache Creek flowing through the creek at the commencement of the Moore Ditch, except at times of high freshets.
>
> That the ditch is 18 feet wide and 10 feet deep, and that he is informed and believes the same is capable of carrying 180 cubic feet of water running at a velocity of 4 feet per second.
>
> That he is entitled to have the waters of said creek flow uninterruptedly down the creek and into and through his ditch at all times when there is not water in said creek in excess of said amount. Later this complaint is amended to show that Moore is a riparian owner.

For answer the Clear Lake Company admits the diversion of the waters, but enters a denial of all the alleged rights of the plaintiff and further denies:

> That the water diverted by the defendant is or could be of any value whatever to the plaintiff, and avers, according to and upon its information and belief, that none of the water which is or ever has been diverted to the defendant's ditch ever could or would reach the point in the natural channel of said creek where plaintiff claims the right to divert the same; and, on the contrary, that all the waters flowing in said creek, at the point where the defendant diverts the same, was before such diversion, and if not diverted would continue to be lost and absorbed in the earth and in the air before it reached the point where plaintiff claims the right to divert the same; and that all the water which ever did flow in Cache Creek at the point where the plaintiff claims the right to divert the same rises in springs and collects in watersheds situate below the point where defendant diverts water from said creek, and wholly independent of the water flowing in said creek at said last-named point.

The defendant also avers:

> That it has been in sole and uninterrupted possession of all waters, water rights, franchises, and property which it now holds, and which it is charged in said complaint with holding, without interruption, for more than five years previous to commencement of suit.

The amended answer of the defendant denies the amended complaint. Again Moore is nonsuited, and costs to the amount of $228.30 are taxed against him.

September 3, 1880, Moore files a new complaint with the superior court. Complaint and answer in this case are practically identical with the last proceeding. Judgment was rendered for the plaintiff August 20, 1883. It read as follows:

> The court finds:
>
> (1) That all the allegations of the complaint are true, except that the capacity of the ditch of the plaintiff described is 432 cubic feet of water per second.
>
> (2) That all the allegations of the answer herein are untrue.
>
> Ordered, adjudged, and decreed:
>
> (1) That plaintiff is the owner of and entitled at all times to appropriate and take out of the waters of Cache Creek 432 cubic feet of water per second at the head of that certain water ditch belonging to plaintiff and generally known as the Woodland or Moore Ditch; to direct said waters into and through said ditch; and to use the same and furnish the same to others to be used for domestic, stock, and agricultural purposes, all without any interruption on the part of the defendant.
>
> (2) That defendant, and all and each of its officers, servants, agents, and employees, be and are hereby forever enjoined and restrained from diverting any of the waters of Cache Creek by any means whatever, or in any manner whatever interfering with the natural flow of water around said creek, and in the plaintiff's said ditch, at any and all times where there is not sufficient water naturally flowing in and down said creek to supply plaintiff's said ditch with the full amount of 432 cubic feet of water per second.
>
> (3) That plaintiff recover costs taxed at $459.99.

By what evidence the court was guided in fixing the amount of the appropriation at 432 cubic feet per second does not appear, as the testimony was never transcribed. There is no evidence in the works as they exist to-day that any such volume ever was or could have been carried by the Woodland Ditch.

The case was appealed. The only important points raised in appeal were the sufficiency of the complaint and findings to support the judgment. The judgment was affirmed and a rehearing denied.

The Clear Lake Company's enterprise was abandoned. A few of the landowners in the vicinity of Rumsey keep up the headgate and temporary dam, so that occasionally a little water is taken through the ditch for their orchards and gardens and a few small patches of alfalfa. The area irrigated is about 100 acres. Plate XVI shows the condition of this ditch at the present time. The water now used is carried in the small flume shown on the lower bank. These people at Rumsey claim as riparian owners, but their rights are unrecorded and undefined, and all that has protected them from ruinous litigation is the insignificance of the volume diverted.

The Clear Lake Company also began the construction of extensive works a short distance above the town of Capay. Here they built a substantial timber dam and did some work on two canals designed to water a large portion of the valley on both sides of Cache Creek. These works were also abandoned. Plate XVI shows the ruined dam. It is estimated that the Clear Lake Company has in all spent some $150,000 on its various enterprises in this locality.

On the farm of D. Q. Adams, a few miles east of Capay, on the north side of the creek, a small ditch was constructed in 1870 to irrigate a vegetable garden conducted by some Chinamen. This was enlarged and extended in 1871 or 1872, and again in 1878, and still again in 1882. The ditch as originally constructed in 1870 carried 3 or 4 cubic feet per second and watered about 20 acres. By 1888, through changes, extensions, and enlargements, it had a capacity at the head, according to evidence later submitted in court, of 248 cubic feet per second, and a mile and a quarter below the head 41 cubic feet per second. It then extended to near Cacheville and watered some 300 acres.

In the summer of 1864 a company of farmers and landowners in the western part of the valley organized the Cottonwood Ditch Company and began a ditch on the south side, starting from a point near Capay and extending to 1 mile below Madison. The ditch was partly constructed and the dam put in, but during the winter it was washed away by the floods. The ditch was never used.

In 1877 the Capay Ditch Company was organized and began the construction of another ditch, taking water from the creek at the mouth of the gorge above Capay, near the site of the large dam of the Clear Lake Water Company, of which we have before spoken. They acquired the rights of the Cottonwood Ditch Company (whatever they were). The line of the new construction crossed the old line in several places, but whether the old channel was utilized is not clear. The opening of the Capay Ditch, with its promise of better agricultural methods, was celebrated with rejoicing as an important event in Yolo County history.

As the use of water extended under the Adams, Capay, and Woodland ditches, it became apparent that at certain seasons there was not water enough for all. The owners of the Adams and Capay ditches were able to harmonize their interests, but between these and the Woodland management there could be no peace. Believing that his rights were invaded, and fearing that the continuous adverse use of the water by the upper ditches might ripen into a claim which would ultimately dispossess him of his rights, Moore was again compelled to get into court.

In 1882 the case of James Moore *v.* The Capay and Adams Ditch companies appears in the records of the superior court of Yolo County. A temporary injunction was asked restraining each of the above companies from taking water from Cache Creek, and asking for an adjudication of the rights of the plaintiff and defendant. Moore now claimed 20,000 inches under a 4-inch pressure (400 cubic feet per second). His claim is based on—

(1) Appropriation of this volume of water, alleging ownership of a ditch with capacity to carry the amount claimed.

(2) The right of a riparian owner, alleging ownership of riparian lands to the amount of 1,056¼ acres.

For answer the Capay Ditch Company denies the plaintiff's appropriation exceeds 500 inches (10 cubic feet per second), and alleges—

(1) Ownership of Capay Ditch and appropriation and use of 10,000 inches of water flowing under a 4-inch pressure (200 cubic feet per second).

(2) Ownership of 5,697.36 acres of land by its stockholders, and the rights of its stockholders and riparian owners to use the water for the irrigation of their land.

(3) Prescription by adverse use under claim of use for more than five years.

The answer of Adams also denies that the plaintiff's appropriation exceeds 500 inches. He, too, alleges—

(1) Ownership of land on the stream.

(2) Ownership of ditch and the appropriation of 8,000 inches of water under a 4-inch pressure (160 cubic feet per second).

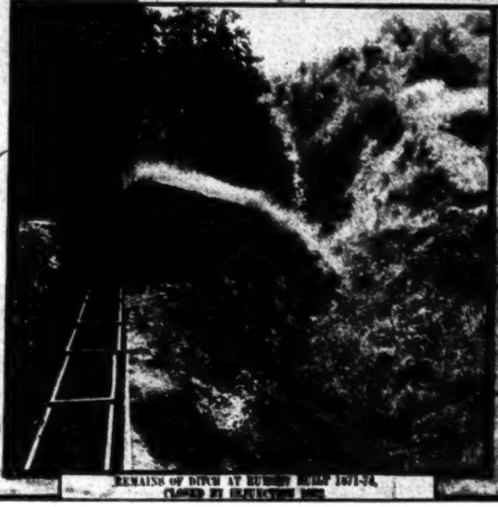
(3) Right by prescription.

CACHEVILLE DITCH, BUILT 1860, ABANDONED 1879.

CAPAY DITCH AFTER 18 YEARS OF TEMPORARY INJUNCTION.

Irrigation
Works
ABANDONED
as result
of
LITIGATION.
YOLO COUNTY,
CALIFORNIA.

RUINS OF CLEAR LAKE CO'S DAM ABOVE CAPAY.



REMAINS OF DITCH AT RUMSEY BUILT 1871-74,
CLOSED BY INJUNCTION [illegible].

ADAMS DITCH, IN LITIGATION SINCE 1882.

The temporary injunction prayed for was granted and the operation of the Capay and Adams ditches ceased.

The battle royal was now on. Eminent lawyers and expert engineers were engaged for the preparation of the case.

A theory of the defense, of which much was made in this trial, was that the waters of the creek, sinking in the channel at Capay, did not again appear, but passed off through the gravel strata to the southeast, and that the waters which appeared in the channel below Madison Bridge had their source in an underground supply coming from the hills to the northwest through a depression known as Hungry Hollow. An elaborate and expensive survey was made for the purpose of establishing this contention. Existing wells were examined and many new ones bored for the purpose of showing the character of the underground strata and the water levels of this territory. The complainant was equally strenuous in his contention that the waters sinking at Capay were the same that reappeared above his dam, and that to allow these upper ditches to take water could only result in ruin for him and distress for those who depended on his ditch for water. He, too, had his experts in the field gathering facts and figures to substantiate his theory of the course of the underground waters.

April 24, 1888, the cause came to trial. For weeks the case dragged its slow length along, adding volume after volume of testimony, exception, and objection. Expert witnesses for the plaintiff testified to the class of facts that they had been sent out to find, and those for the defense were equally loyal to their employers. May 17, 1888, after six large volumes of typewritten testimony had been taken, the presiding judge stated that on account of sickness it would be impossible for him to hear further testimony. By stipulation the hearing was continued before a court commissioner appointed for the purpose. Two more volumes of oral testimony were added and the case was submitted May 24, 1888.

To find any capable jurist who would undertake the appalling and thankless task of digesting all this accumulation of fact and theory, exception and objection, and who was acceptable to both parties to the controversy, was not easy. Twelve years have passed, and no referee on whom the contending parties have been able to agree has ever been willing or has found time to take up the matter and reach a decision. The cherished hope of the men who built these works of an improved husbandry, which should restore and perpetuate the fertility of their fields, failed. The vision of meadow and pasture and orchard and vineyard and garden and pleasant homes vanished. In its place continued the dull round of plowing and sowing and reaping wheat, while diminished production keeps pace with soil deterioration and the mortgage consumes.

Through all these years the temporary injunction issued thirteen years ago continues in force. The Capay Ditch has been plowed in and the Adams Ditch is a wreck, irrigating about 20 acres and carrying a little water for stock. Plate XVI shows sections of the Capay and Adams ditches that have escaped obliteration.

April 15, 1884, James Moore died. The clauses of his will disposing of the ditch are:

> 9. I give and bequeath to my grandsons, William Wall and James Moore, and to the survivors of them, that property known as the Woodland Ditch, including all its water rights and extensions to

be made thereto, and about 50 acres of land at the head of the ditch; * * * and also all land occupied by said ditch and branches; and also the strip of land on each side thereof reserved for the purpose of said ditch in the several bequests herebefore made to my wife and children; all to be held by them or the survivors of them in trust, however, for the following purposes:

(1) To hold and retain said ditch, with all the rights, privileges, and appurtenances pertaining thereto, and all the land held in connection therewith, so long as said trustees or survivors of them shall live.

(2) To keep said ditch and branches in good repair and fit for service, and make such extensions and additions as may seem best.

(3) To collect all the rents and profits for the sales of water or otherwise, and from the money so received pay all expenses for repairs, additions, and extensions, and a reasonable compensation for the care and management of said property; and pay over the balance, if any, to my wife during her life, and after her death the net income to be divided annually into five shares, one share to be paid to each of my children living, or if dead, then to their descendants. In no case shall any debt be contracted in said property which shall exceed the receipts from it.

10. Inasmuch as the said William Wall and James Moore are minors, * * * I hereby appoint my wife to manage and control said property so long as she may live, and at her death * * * that my son Robert Moore shall manage and control said property until the trustees first named shall have each arrived at majority. * * *

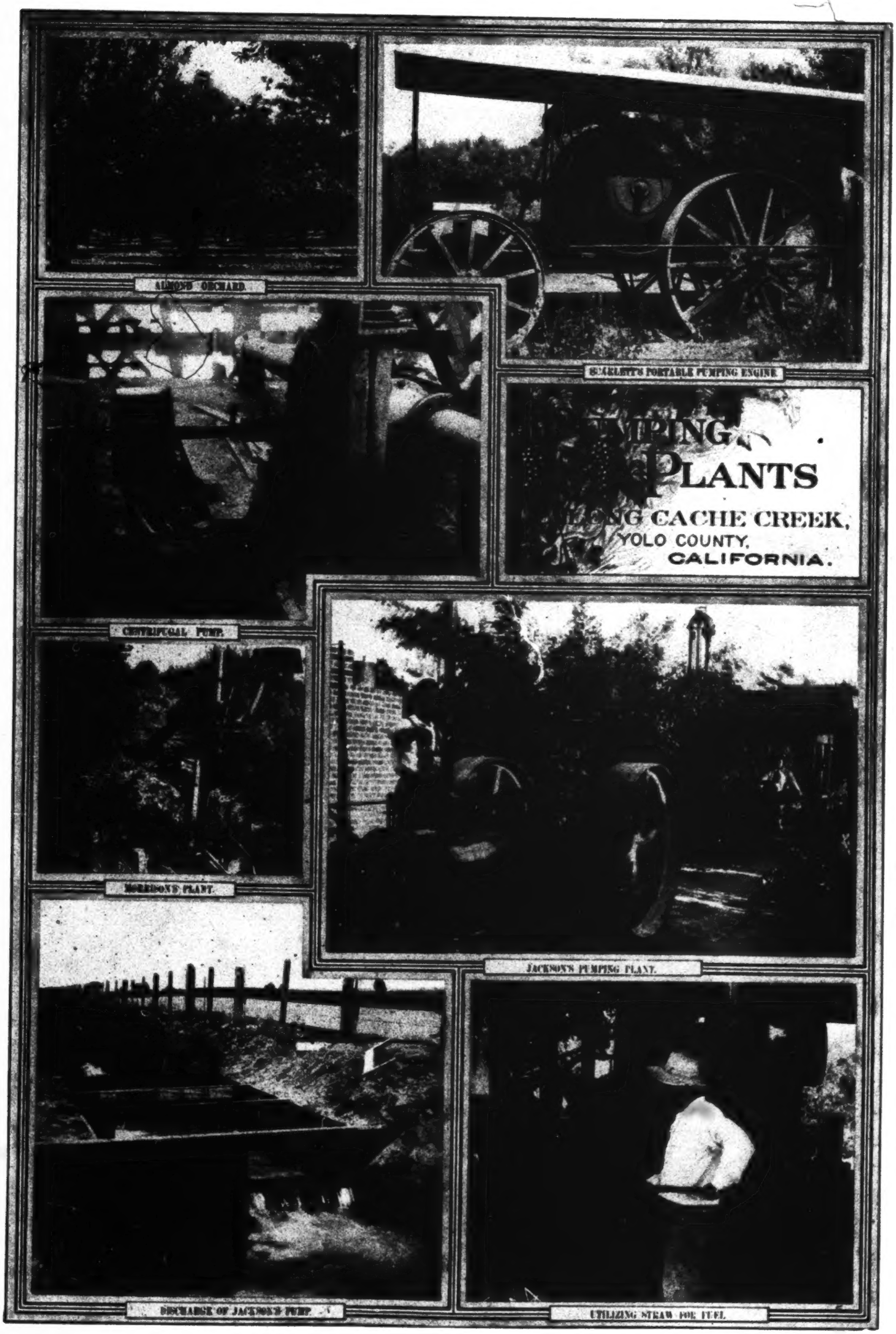
11. Upon the death of said trustees and survivors of them, all the property herein bequeathed to them in trust shall be sold and the proceeds divided into five parts. One for each of my children, and in case of death of any one or more of my said children, then the descendants of such deceased shall take the share. * * *

Thus, with a strange mingling of faith in the enterprise, which for more than a quarter of a century had claimed his time and strength, and of misguided love for his offspring, did this strong-willed old man entail on his two innocent grandchildren the burden which he now laid down.

In 1886 the permanent dam was washed away. Hampered and hedged about by the provisions and limitations of this strange bequest, the trustees have found themselves unable to replace the dam or make other much-needed repairs. They have not been able to operate the ditch to the satisfaction of either themselves, the heirs, or the water users. During all these forty-four years since James Moore first began his ditch, nearly half a century, the waters of Cache Creek have been going to waste, and for all this outlay of energy and treasure there is nothing to show but these voluminous court records and one mismanaged ditch, irrigating in an ineffectual, unreliable way from 5,000 to 7,000 acres per annum out of a possible 40,000 to 50,000 acres that the natural flow of this stream should water and make fruitful. The physical difficulties to overcome are insignificant. Time after time energy and capital have brushed these aside only to find themselves involved in a maze of endless litigation which leads nowhere and settles nothing.

In 1864 the Clear Lake Company built a dam and mill at Lower Lake on Cache Creek a short distance below the outlet of Clear Lake. This dam interfered with the flow at the outlet and was so operated that in times of high water the town of Upper Lake and all the lowlands adjacent to the lake were inundated. Remonstrance proving unavailing, the assistance of the Lake County court was invoked. When the case came to trial, tradition reports that the presiding judge, whose sympathies were evidently with the sufferers, decided that this court could furnish no legal remedy for the difficulties complained of. In rendering this decision, while commenting on the case, the judge intimated that there was a law "higher than statute or procedure

PLATE XVII.



PUMPING PLANTS ALONG CACHE CREEK,
YOLO COUNTY,
CALIFORNIA.

ALMOND ORCHARD.

SCARLETT'S PORTABLE PUMPING ENGINE.

CENTRIFUGAL PUMP.

MORRISON'S PLANT.

JACKSON'S PUMPING PLANT.

DISCHARGE OF JACKSON'S PUMP.

UTILIZING STRAW FOR FUEL.

of court," which when the necessity arose might be invoked. A few days later a force of citizens of Lake County appeared at the mill, and after removing carefully everything that was movable destroyed the works. This was in 1868. The milldam and mill were never replaced, but Lake County is still paying interest on bonds issued to liquidate the damages incurred through this appeal to "higher law."

PUMPING PLANTS.

Discouraged by the difficulties attending the use of water from the ditches, a number of pumping plants have been established along and near Cache Creek. Views of some of these are shown in Pl. XVII. These were visited, and data concerning their operation collected from the owners. A table exhibiting the more important facts collected is herewith given. Several of these plants pump directly from the creek, and the farmers who use wells would prefer the water from the stream if it could be obtained when needed. The surface waters carry elements of fertility which are wanting in the underground supply. The only advantage of the well is its independence of other uses. Except the Yolo orchard, the Jackson, the Blowers, and Peart places, the farms are small. They well illustrate what may be done on small areas well cultivated when water can be had as needed. The expense of pumping is considerable, and for field crops would, except under very careful management, be prohibitory. But with orchard and vineyard and garden, where the value of the crop as compared with the area to be irrigated is great, it can be made a success. The water is raised from 10 to 35 feet, and the fuel used is wood, coal, gasoline, brush, or straw, the last named probably being the cheapest.

There are 20-acre farms in the list given that employ more help and whose crops bring greater net returns than many of the large wheat farms of Yolo County. The table contains material worthy of careful study and of further discussion, but time and space forbid.

Pumping plants in Cache Creek Valley.

Owner.	Source of water supply.	Reliability of supply.	Total cost of plant.	Average cost of operating plant per day.	Capacity of plant per day.	Acres farmed and to what planted.	Acres irrigated.	Irrigations per annum.	Total yield per annum.	Average yield per acre.	Money returns per annum.	
											Gross.	Net.
					Acres.							
G. T. Hennigen	12-inch well 160 feet deep.	Does not furnish enough for pumps.	....	$15.00	7	25 in berries	......	......	....	....	......	......
W. W. Nelson..	Cache Creek.....	Scarce during July, August, and September.	$2,000	15.00	5–7	5 in prunes, 35 in alfalfa.	30	2–3	280 tons of alfalfa, 8 tons dried prunes.	8 tons alfalfa, 1.6 tons dried prunes.	....	......
F Sanderson ..	.....do	But little available after July 1.	(a)	9.00	4–5	7 in prunes, 10 in apricots, 5 in almonds.	17	3	10 tons dried prunes, 1.75 tons dried apricots, 2,780 pounds almonds, 5,750 pounds pears.	1.4 tons dried prunes.	....	$1,036
Wm. Daniels ..	.....do	.....do	(a)	10.00	3–4	5 in prunes	5	1–3	10 tons dried prunes.	2 tons dried prunes.	$550	325
O. J. Adams....	.....do	.....do	400	2.00	2–3	4½ in prunes, 3 in peaches, 3 in apricots, 2 in oranges, 1 in alfalfa.	13	4	5 tons dried prunes, 3 tons dried peaches, 1.5 tons dried apricots, 150 boxes oranges.	1.1 tons dried prunes, 1 ton dried peaches, 1.5 tons dried apricots, 75 boxes oranges.	900	600
Mrs. Peart	.....do	.....do	5,000	12.00	12	12 in prunes, 10 in apricots, 40 in grapes, 10 in pears.	70	4	12 tons dried prunes, 12 to 15 tons dried apricots, 10 tons green pears, 24 tons raisins.	1 ton dried prunes, 1.5 tons dried apricots, 1 ton green pears.	3,750	......
W. E. Proctor ..	.....do	Supply small in three fall months.	500	3.50	2	5 in grapes, 15 in berries, apricots, prunes, apples, and vegetables.	5	......	....	....	......	......

R. Morrison	do	do	*b* 150	9.00	5	10 in orchard, 7 in vineyard.	10	2	11 tons dried prunes, 0.5 ton dried apricots, 1.5 tons almonds, 24 tons grapes.	3.4 tons grapes		
T. G. Baty	do	do	*b* 150	9.00	5	17 in almonds	17	2	9.5 tons almonds	0.5 ton almonds	1,540	600
A. D. Martin	do	do		2.00	6	12 in strawberries, 4 in blackberries, 2 in raspberries.	18	(*c*)	3,000 cases berries	166 cases berries	3,300	2,000
C. H. Steinburg	Two 2-foot wells 40 feet deep near Cache Creek.	Sufficient	1,000	5.00	4-5	13 in berries, 20 in alfalfa and vegetables.	20-30	(*d*)	First crop small			
W. S. Hayden	Cache Creek	Fails about July 1	(*a*)	13.00	5	12 in prunes, 12.5 in almonds, 1 in peaches.	12-30	1-2	40 tons dried prunes, 5.75 tons almonds.	3.3 tons dried prunes, 0.5 ton almonds.	3,440	
L. Cramer	Cache Creek and 2-foot well 55 feet deep, 10 feet from Cache Creek.	Creek fails about July 1, well satisfactory.	1,400	5.50	6-7	15 in prunes, 5 to 10 in alfalfa.	20-25	2	40 tons dried prunes.	2.6 tons dried prunes	3,000	1,800
J. R. Fisher	Two 12-inch and one 8-inch wells.	Sufficient	600	8.00	2.5	10 in prunes	10	1-3	12.5 tons dried prunes.	1.25 tons dried prunes.	500	250
S. V. Scarlett	Two 12-inch wells 80 feet deep.	do	1,900	8.00	5	10 in apricots, 6 in peaches, 4 in almonds and pears.	20	2	60 tons apricots, 30 tons peaches, 0.5 ton almonds.	6 tons green apricots, 5 tons green peaches, 0.12 ton almonds.	1,900	
Yolo Orchard Co.	Cache Creek and well 68 feet deep, into which water is siphoned from Cache Creek.	Supply fails in fall months.										
C. S. Merring	Three 10-inch wells 45 feet deep.	Sufficient		7.50	12	18 in alfalfa	18	2	5 crops, 2 tons per acre.	10 tons alfalfa		450
J. E. Scarlett	Three 12-inch wells 42 feet deep.	do	700	12.00	6	60 in alfalfa, 20 in prunes, 20 in almonds.	80	1-3	40 tons dried prunes, 4.5 tons almonds, rented alfalfa at $7.50 per acre.	2 tons dried prunes, 2.2 tons almonds.		2,850

a Hires pumping. *b* Owns pump, hires power. *c* Once a week during season. *d* Every ten days from May 1 to October 1.

Pumping plants in Cache Creek Valley—Continued.

Owner.	Source of water supply.	Reliability of supply.	Total cost of plant.	Average cost of operating plant per day.	Capacity of plant per day.	Acres farmed and to what planted.	Acres irrigated.	Irrigations per annum.	Total yield per annum.	Average yield per acre.	Money returns per annum.	
											Gross.	Net.
					Acres.							
W. Garrett	Well			$9.00	5							
F. Martinelli & Co.	Three 5-inch wells	Sufficient		6.00	3	30 in vegetables	30					
J. R. Jones	One 30-inch well 20 feet deep.	do		10.00	11	20 in alfalfa	20	1-2	90 tons alfalfa	4.5 tons alfalfa	$495	
J. Stephens	Four wells	do	$150			Peaches, apricots, prunes, cherries.	15-20					
E. F. Haswell	Cache Creek	do				4 in prunes, 12 in plums, apricots, alfalfa.			12 tons dried prunes, 20 tons plums, 12 tons apricots, 20 tons alfalfa.	3 tons dried prunes, 1.6 tons dried plums.	1,155	
P. Martinelli	One 8-inch well 35 feet deep.	do				6 in vegetables	6					
Byron Jackson	Moore Ditch and six 8-inch wells 78 feet deep.	Ditch unreliable; wells will apparently furnish sufficient.	2,000	12.00	8	60 in prunes, 25 in apricots, 75 in grapes.	160	1-2	220 tons dried prunes, 9 tons dried apricots, 3.5 tons dried silver prunes, 149 tons raisins.	3.6 tons dried prunes, 0.36 ton dried apricots, 2 tons raisins.	34,030	
R. B. Blowers & Son.	Moore Ditch and 18-foot well 25 feet deep.	Generally sufficient	5,000	5.00	6	25 in prunes, 12 in grapes, 9 in pears, 10 in olives, 2 in mixed orchard.	58	2	12 tons dried prunes, 75 tons green grapes, 30 tons olives.	2.1 tons of dried prunes, 6.25 tons grapes, 3 tons olives.		

DUTY OF WATER.

The investigation on Cache Creek did not begin until June 26, when the irrigation season was so far advanced that it was impossible to make satisfactory observations as to the quantity of water needed in this locality to secure the best crop results.

With a view to reaching some general conclusions along this line, the statistics collected from the users of water under the Moore Ditch were carefully studied. But it was soon evident that no conclusions of value concerning the duty of water could be reached by the study of results obtained under such adverse conditions as here prevailed. The statistics collected from the pumping plants were more satisfactory, in that the time of using the water was under the control of the irrigators and the crop returns were better; but as few of them were pumping at the time when we made our investigation, we had in most cases no way of determining the depth of water used except by computation from the reported capacity of the pump and the acreage reported as irrigated per day. The depths were all computed, and a table showing the duty of water and the crop returns was prepared for publication; but a study of the table shows that either the capacity of several of the pumps is much overrated or that water is used with great extravagance (in pumping the cost is an effective check on extravagance), and we saw no evidence of such excess in the use of water on these tracts as the reports would indicate. The probabilities are that the owners of the pumps are mistaken as to their capacity, and that the volumes used are much less than the computations show. The table has therefore been omitted from the report. Next year the observations in this locality will begin with the irrigating season and be continued throughout the year under conditions more favorable for accurate measurements and with greater certainty of reaching safe conclusions.

PRESENT CONDITIONS AND POSSIBILITIES OF YOLO COUNTY.

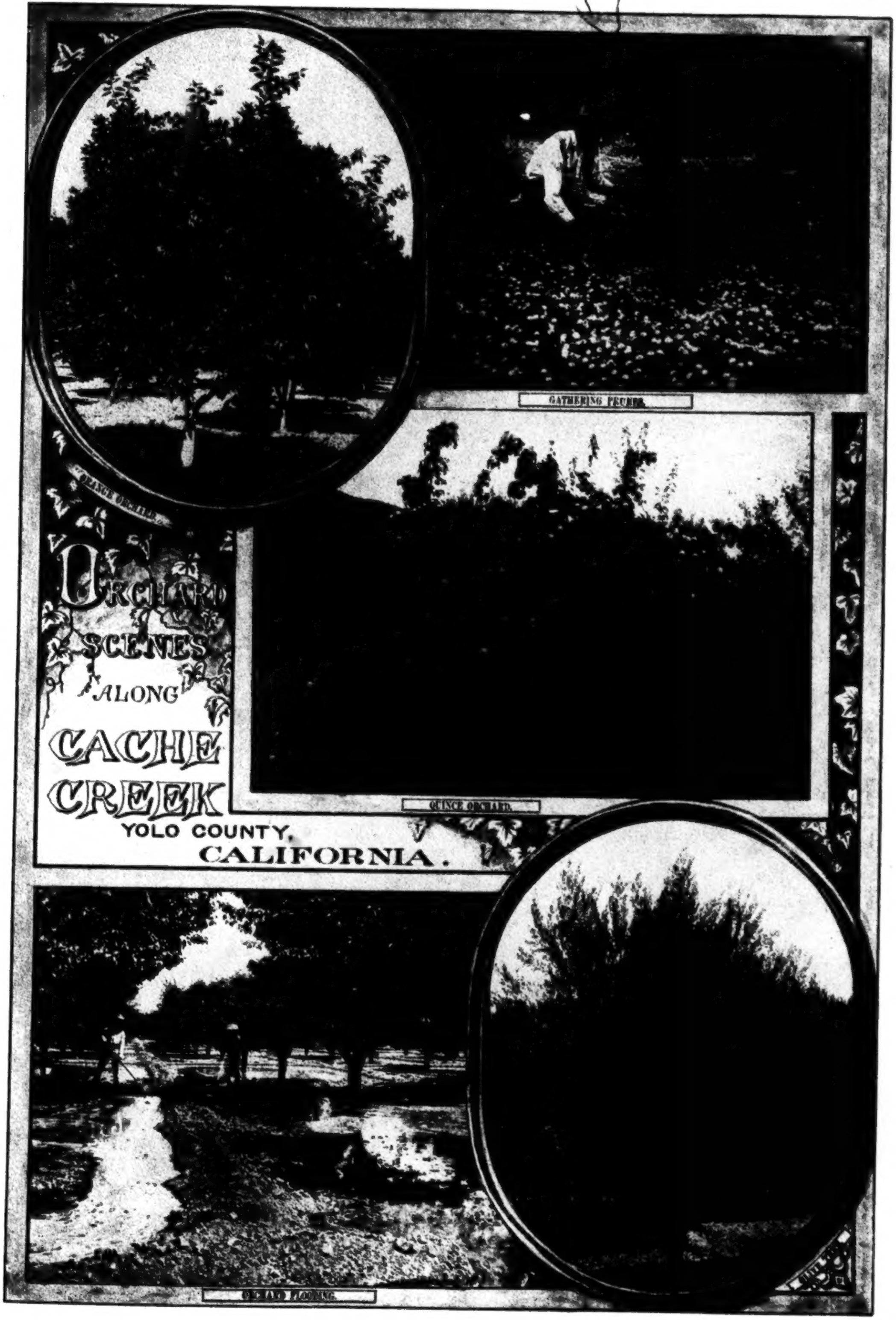
With the exception of the few pumping plants described, the Moore Ditch holds the field. The capacity of the ditch as managed is utterly inadequate to the demands of the territory covered. Except for those who are most favorably situated, there can be no certainty of obtaining water when desired. When water is most needed there are always more users wanting it than can possibly be served. The lack of certainty, or, rather, the certainty that all can not get water, operates to discourage the growing of crops requiring irrigation. The cost of leveling the land and preparing the levees for flooding, which is almost the universal custom here, is no small item of expense. Unused levees are not only useless, but are impediments to cultivation and harvesting. The water user, disappointed in getting water for lands already prepared, has little encouragement to continue or extend his efforts. The more progressive farmers, who are convinced that the growing of grain is impoverishing the soil and who would gladly change to a mixed husbandry with rotation of crops, are still compelled to grow wheat year after year at a loss. With water these lands will produce four to six crops of alfalfa annually, aggregating 5 to 10 tons per acre. With this alfalfa and the other forage crops that would be possible with an assured supply of water, the growing of cattle and sheep, the feeding of range stock, and hog raising would all be profitable industries. The possibilities of this section for dairying have been amply demonstrated by the farmers in the vicinity of Woodland and Yolo. The long season that it is possible to keep stock on green feed in this climate when water can be supplied for the irrigation of the pastures makes the conditions here peculiarly favorable for this and all kindred industries. The only drawback is the lack of water for pasture and for forage crops.

If the history of this "chosen valley" was different from others we might look for the cause of all this dismal failure in the character of the people who have been engaged in these enterprises, but the managers and promoters of these failing ditch enterprises were not weaklings. Their quality is approved by their success in other lines before and since. Their fault was a too great faith in a system which was only lack of system, whose pretended regulation gave only fancied security at first to later add to their embarrassment. Everywhere, all over California, wherever there has been enterprise enough to attempt to use the water, the story is the same. The energy and capital of water users and appropriators are consumed in litigation. The cause is not in the people who seek to utilize the water, but in the law regulating the appropriation and use of water.

There is now shipped out of Yolo County annually 50,000 to 80,000 tons of wheat. If the water wasted in Cache Creek were conserved, and as it comes down to water the fields used in manufacturing this wheat into flour, one-third of this tonnage might be left behind to be used in the production of pork and mutton and beef and dairy products. California is shipping to-day from Chicago and Omaha and Kansas City bacon and lard that she can produce within her own borders as cheaply as they can be placed on the market of the great corn-producing States. The supply of poultry and eggs and butter and cheese which is now shipped into California across half the continent could be profitably furnished by the home production. She can supply her own people and still have surplus for export in her Pacific trade. There ought to be in Yolo County 50,000 acres in alfalfa instead of 5,000, and stock enough to consume it.

We have here a country of marvelous possibilities, a soil rich in all the elements of plant growth, with surface smooth and easy of tillage, a climate whose summer heat and winter cold are tempered by the breezes of the Pacific, so equable that here all the choicest products of the temperate zone and of the subtropics are grown alike in perfection. Here flourish side by side the apple, the peach, the pear, the plum, the apricot, and grape, along with the orange, the lemon, the lime, and the fig. Here the oak and the pine, there the palm and the pepper tree. The roses bloom winter and summer. The orange carries its fruit through the winter, the oleander is a tree and the heliotrope a hardy shrub.

As if to crown her good gifts to this favored country, during the season of harvest and fruitage nature sends a cloudless sky. The grain, ripe for the sickle, may stand uninjured for months waiting the busy harvester. The warmth and light develop rich juices and exquisite coloring of flower and fruit and a wealth of bloom and perfume unknown in the Eastern climate. Without rain, the curing of forage is attended with none of the uncertainty and anxiety that attends this work in countries where the rain may come at all seasons. The advantage of the clear sky is especially seen in the preparation of dried fruits. The California dried fruits—the peaches and


ORCHARD SCENES ALONG CACHE CREEK
YOLO COUNTY,
CALIFORNIA.
ORANGE ORCHARD.
GATHERING PRUNES.
QUINCE ORCHARD.
ORCHARD FLOODING.

prunes, apricots and nectarines, and figs—are for the most part dried in the sun. This makes possible the saving of much defective fruit, and affords an outlet for the surplus which can not be canned or shipped or used locally. Indeed, the risks attending this method of dealing with the fruit are so much reduced and the results so satisfactory that many of the larger fruit growers dry nearly all their product. Unlike the fresh fruit, it is not perishable, and the risks of shipping are small. California dried fruit is staple and has a regular quotable value in the markets of the world.

If in this favored valley health or needed rest call for change of climate or scene, within easy reach on the west is the bracing air, the health-giving springs, and all the wealth of scenic beauty for which the Coast Range is so justly famed. To the north the snows and the mountains of Shasta; to the east the wild and rugged Sierras, with all their attractions of lake and forest and crag and stream; to the south the ocean beach, with its moist and cooling breezes. All these to choose from and within easy reach of even slender means.

For a market there are the interior and coast cities and the lumbering and mining camps of the Sierras and the Coast Range. During the summer the Southern Pacific, with its fruit express, taps this territory, and through eastern connections places its fresh fruits and early vegetables on all the markets of the mining States, the Middle West, the Central States, and even the cities of the Atlantic seaboard and Canada. Later in the season over the same great highway are carried the less perishable products of the cannery and the vineyard, the dried fruits, the nuts, and the citrus fruits to the great distributing centers of the East, whence they find a market east and west, north and south, and even across the Atlantic. Within easy rail and water communication to the south lies San Francisco, the great commercial entrepôt of the Pacific coast, with her matchless harbor, on whose waters might ride in safety the commercial navies of the world, and through whose Golden Gate is pouring an ever-swelling tide of commerce with our growing Pacific coast cities and with Alaska, Hawaii, and the Philippines; with Mexico, Central America, and Peru; with Australia and New Zealand; with Russia; with India, China, and Japan, and with all the countless islands of the Pacific and the eastern seas. With generous soil and favoring climate and the world for a market, this is indeed a favored land.

DEFINITIONS OF TITLES TO WATER.

The farmers of Sacramento Valley under the existing system are exhausting the fertility of their lands and wasting their substance in a failing system of agriculture, while the waters that should make their thirsty fields fruitful and themselves and their families comfortable and prosperous go idly by to trouble the lower lying lands and to breed malaria in the swamp. These farmers have a right to the use of the water, and they should know the limit of its appropriation. It is clearly the duty of the State to provide—

First, for a clear definition of every beneficial use now made of these waters; second, to make clear the limit of riparian rights; third, to provide for the determination of what waters remain unused; fourth, to provide for regulation and control when new appropriations are sought; fifth, to provide a complete record of each perfected right and of each application or permit for a new diversion or use; sixth,

to provide an efficient administrative system, adequate for the proper distribution of the water to those entitled to its use.

For the defining of existing rights the machinery and methods of the ordinary court are not fitted. With all the thirty years of litigation over Cache Creek claims, nothing has been accomplished except to render impossible the use of water. The injunction works while the court sleeps.

The tribunal that deals with this matter adequately and finally must take account of physical laws as well as statute and precedent. It must have all the necessary appliances for securing, of its own motion if necessary, accurate and reliable knowledge of the capacities of ditches, the uses made of the water, and all other physical data needed for determining fully the amount and character of an appropriation.

The court that fixed the volume of the water appropriated by the Moore Ditch at 432 cubic feet per second did not, and probably could not, know that the passage of that volume of water through the ditch was a physical impossibility, or that even half of it would have hopelessly wrecked the works, but the decision stands approved by the highest court of the State.

The custom has been to treat a controversy of this nature as a private matter, in which only the parties to the controversy are interested. But the adjudication of a right on a stream in an arid country is a public matter, affecting the rights of every other claimant on the stream, and the tribunal fixing the limits of any appropriation should have at its hand full information concerning each claim on the stream and full knowledge of the capacity of the stream to supply the demands made. A right can not be adequately determined without full consideration of all other existing rights, and when once fixed should be clearly defined as against every other conflicting claim. Until an adjudication means this it means nothing.

The limits of the riparian rights must be more clearly defined. As the matter now stands, it may mean anything. In departing from the broad principle that courts should be governed in their interpretation of law by the natural conditions and necessities growing out of the environment of the people who make the courts, we have been led into a maze of hopeless absurdities. Moore claims water as a riparian owner, to be used on lands clearly not riparian. The owners of the Capay Ditch, with lands stretching for miles away from the stream, claim that it is all riparian. The man with 20 acres on the stream thinks the right belongs to him, and not to his neighbor 10 rods away. Until some definite, reasonable limitation is placed on this right there can be no certain progress. When we know the limits of the right its value can be determined, and then if it stands in the way of progress it can be condemned, or purchased and paid for.

The determination of the amount of water available for new uses is an exceedingly important matter. If all the water in a stream has been utilized it is just that the appropriator and the would-be appropriator should be apprised of the fact, and it is not right that the homes of those who have used the water should be jeopardized by a new use. Either the new claimant must fail or the old must suffer and both be involved in controversy. If there is unused water, there is no reason why it should not be officially known and the conditions set forth under which it can be secured. This determination of the amount of unappropriated water is not a simple problem; it requires a full knowledge of the régime of the stream at all seasons, full information

as to all the uses to which the water is now applied, and large experience in its use on different soils and under different conditions.

No new appropriation should be ever permitted until it has been considered by competent authority. The tribunal defining the old claims would be admirably fitted to pass upon the new. The amount and character of the diversion proposed and its effect upon other established appropriations should all receive careful consideration, and the permit, if issued, should contain such limitations as will effectually guard against unlawful interference with the prior users.

The record should show the location, use to which applied, the volume and the priority of the appropriations from every stream and in every watershed in the State. The records should be in a central office, and be so systematized that information desired concerning any claim or any stream in the State could be given at once. With such a record, a letter addressed to the official in charge would bring back complete information as to the standing of any claim or the conditions on any stream.

But all this is only preliminary. Last and most important of all is the distribution of the water to the claimants in accordance with the adjudication and the record. For this an efficient administrative system will be needed. The executive officers should be in charge of the record and be provided with efficient assistants in the various watersheds. To this department all complaints in regard to the use of water should be referred. This would secure prompt action and the distribution of water to the party legally entitled to its use.

With rights defined and full protection assured for all beneficial uses of water and an efficient and prompt distribution to the rightful users, there is no reason why the waters of Cache Creek and Clear Lake should longer run to waste. With the facilities for storage at minimum cost and the unlimited opportunities for the development of power, Lake County has at her hand the opportunity of easy and direct communication by rail and water with the outside world. This would bring an easy market and increased population to her borders and the development of all her agricultural and horticultural resources. The advantages of Lake County as a sanitarium and pleasure resort and as a region for picturesque homes can never be fully realized without easier means of transportation. Cache Creek and Clear Lake have in them the solution of this problem. Nor would the uses for power cease with Lake County. In Rumsey and down Capay Valley and along the foothills bordering the Sacramento Valley there are abundant opportunities for the use of power in putting into more concentrated form the products of this rich farming country, in lighting towns, furnishing power for shops, pumping water for the irrigation of arid lands, the reclamation of swamps, and innumerable other uses—all these without interfering with the use of the water for irrigation or abating its value in developing the unparalleled agricultural and horticultural possibilities of this wonderful soil and climate.

With proper conservation and distribution of the waters that now go to waste in Cache Creek and such subdivision of the lands as would make possible even a moderate realization of her great natural resources, Yolo County ought to furnish independent homes and maintain in comfort and with much of luxury a rural population of many times what she now supports and make of each of her towns a thriving center of trade and manufacture and of social and intellectual life.

REPORT ON IRRIGATION PROBLEMS IN THE SALINAS VALLEY.

By Charles D. Marx,
Professor of Civil Engineering in Leland Stanford Junior University.

IRRIGATION PROBLEMS IN THE SALINAS VALLEY.

Irrigation was practiced in the Salinas Valley by the mission fathers as early as 1791, and traces of an old irrigation ditch belonging to the Mission Soledad exist to this day.

This early beginning of irrigation, however, led to no development. With the secularization of the missions in 1833 and their subsequent decay, the disappearance of most of the irrigation works went hand in hand. This was due in a large measure to the fact that California was a grazing and not an agricultural country. The discovery of gold checked for a time the natural transition from the range to the grain farm, and from the latter to diversified farming. In the Salinas Valley the change has certainly been a slow one, and the irrigation development has been correspondingly slow. This is fortunate for the inhabitants of this fertile valley, because they will be able to profit by the mistakes made by the irrigators in other parts of California; that is, if the recommendations made by the engineers who have studied California irrigation conditions are carried out.

The Salinas Valley lies largely in Monterey County, though some of the tributaries of the Salinas River pass through portions of San Luis Obispo and San Benito counties. More than 100 miles in length and from 3 to 15 miles wide, the Salinas Valley slopes slightly from the Gabilan Mountains on the east and the Santa Lucia Mountains on the west to the Salinas River. The river, with its tributaries, has a total drainage area of 4,940 square miles, divided as follows:

Drainage area of the Salinas River and its tributaries.[1]

	Square miles.
Salinas River direct	1,956
San Lorenzo River	282
Arroyo Seco River	291
San Antonio River	342
Nacimiento River	394
Estrella River	1,675
Total area	4,940

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[1] These areas are the actual areas tributary to the Salinas River. In part of it the run off does not reach the river.

The mean annual rainfall at several stations in the valley is given below. The table is made up from records furnished by the chief engineer of the Southern Pacific Railroad:

Mean annual rainfall in Salinas Valley.

	Inches.
Pajaro	[1] 19.24
Castroville	[2] 16.58
Salinas	[1] 13.55
Soledad	[1] 8.82
Kings City	[3] 10.34
San Ardo	[3] 10.36
San Miguel	[3] 10.22
Paso Robles	[3] 14.89
Templeton	[3] 16.68
Santa Margarita	[2] 24.23

This rainfall was until recently considered sufficient for agriculture. Not many years ago it was written: "It is the absence of droughts which distinguishes the Salinas Valley from other sections of the State where irrigation is required to insure crops." This view is no longer held. Two successive dry years have seriously injured the cattle industry, and in many sections of the valley the grain crops, too, have been a failure. In ordinary years the total rainfall is sufficient to produce crops, yet its distribution is such that to insure crops for the future irrigation will have to be resorted to.

The following summary shows the monthly mean rainfall at Salinas, as reported by the U. S. Weather Bureau:

Monthly mean rainfall at Salinas, Cal., 1872–1899.

	Inches.
January	2.92
February	2.22
March	2.29
April	1.20
May	.45
June	.14
July	.00
August	.02
September	.16
October	.72
November	1.30
December	2.52

In the twenty-seven years covered by the summary no rain has fallen in July, and the rainfall from May to September is hardly appreciable. With such a distribution of rainfall any but the most primitive forms of agriculture are impossible. This fact was recognized by Messrs. Brandenstein and Godchaux, who in 1884 organized the San Bernardo and Salinas Valley Canal and Irrigating Company. The lack of success of this scheme, though attributable to various causes, is in a measure due to the lack of appreciation of the value of irrigation on the part of the farmers. Mr. Brandenstein stated that as a rule men preferred to wait and take their chances on possible rains to the doing of any work which might prove superfluous. The necessity of irrigation, however, is now recognized by the intelligent and progressive farmers of the Salinas Valley, and the waters of the Salinas River and its tributaries will not be allowed to run to waste in the future as in the past.

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[1] Mean of 27 years.

[2] Mean of 12 years.

[3] Mean of 14 years.

The volume of water carried by the river corresponds in general to the amount of rainfall—a torrent in winter, it almost dries up in summer—and to make the best use of it storage is necessary. The extent to which this is practicable will be determined by the results of the reconnaissance survey for storage reservoirs carried on by the hydrographic division of the U. S. Geological Survey last summer.

CLAIMS TO THE WATERS OF SALINAS RIVER AND ITS TRIBUTARIES.

In many cases the recognition of the value of irrigation shows itself only in the filing of a claim for water, since there is a large discrepancy between recorded claims and projects actually carried out. The records of Monterey County show that 70 claims to the water of Salinas River and its tributaries have been filed. Most of these filings make an attempt to comply with the statutory requirements as to giving amount claimed, point of diversion, dimensions of ditch, and the proposed use to which the water is to be put. But they fulfill the requirements in form only. In many of the claims there is an attempt to make the area of the cross section of the proposed ditch in inches approximate the number of "inches" of water claimed, but in others it is hard to tell what dictated the dimensions for these ditches. The Salinas Valley Water Company in one filing claims "50,000 inches under a 4-inch pressure" to be diverted by means of a ditch 30 feet wide on top, 20 feet wide on the bottom, and 5 feet deep. Five months later the same company claimed 16,000 inches to be diverted by means of a ditch 40 feet wide on top and 35 feet wide on the bottom, and 5 feet deep. In the latter case the quantity claimed is less than one-third of that formerly claimed, and the ditch is a half larger. There are two claims filed within three days of each other for 2,500 inches, under a 4-inch pressure. In the first case the water was to be diverted through a ditch 25 feet wide on the bottom and 4 feet deep. The other claimant's ditch was to be 2 feet wide and 2 feet deep. Another filing claims 6 inches of water under a 4-inch pressure, to be diverted through a ditch 12 inches wide on top, 8 inches wide on the bottom, and 10 inches deep. This ditch is large enough to carry about 100 inches as their capacity is usually estimated.

Presumably not more than ten of these seventy filings have been followed by actual appropriations, and even in these cases the amount claimed is in almost every instance much beyond the amount actually used or the capacity of both headworks and ditches. Many of the filings represent the same claim and are repeated often enough to keep the claim alive until the claimants are able to build their works or give up their plans.

The following table is a summary of the claims to the Salinas River and its tributaries, omitting duplicates:

Summary of claims to the waters of Salinas River and its tributaries, filed in Morterey County, Cal.

SALINAS RIVER.

Name of claimant.	Date recorded.	Inches claimed.
Hanna, Rob F	Oct. 16, 1877	154
Kopman, Frank	Oct. 18, 1877	144
Brandenstein, M	Dec. 15, 1882	50,000
Gould, B. F., and Briggs, N. C	Mar. 14, 1893	50,000
Gould, B. F	May 27, 1895	3,000
Brown, W. K. (Salinas Valley L. and W. Co.)	May 9, 1896	50,000
Hartenbower, J. E., and Hurd, B. D	July 3, 1896	45,000
Armstrongs	Aug. 19, 1896	1,000
Spreckels Sugar Co	Sept. 13, 1898	15,000
Do	Feb. 25, 1899	2,000
Somavia, J. G	May 18, 1899	80
Gonzales Water Co	Sept. 18, 1899	16,000
Gordon, W. A	Oct. 23, 1899	5,000
Total		237,378

ARROYO SECO.

Brown, J. H., and Armstrong, W. T	Oct. 20, 1886	10,000
Abbott, E. K	Apr. 13, 1895	1,000
Hall, E. E	Apr. 29, 1896	10,000
Abbott, C. S	May 6, 1896	3,500
Burbank, A. L., and Abbott, C. S	July 11, 1896	30,000
Salinas Valley Water Co	July 17, 1897	50,000
Do	Dec. 22, 1897	50,000
Wood, Wm. P	Aug. 17, 1900	50,000
Do	do	50
Total		204,550

SAN LORENZO.

Abbott, C. S., and Boswell, S. B	Jan. 7, 1878	3,000
Brown, W. K	Aug. 26, 1895	2,500
Brown, John	Nov. 2, 1895	6,000
Total		11,500

SAN ANTONIO.

Millard, I. H	Sept. 27, 1898	10,000

Unfortunately we have no stream-flow data from the Salinas River. It is, however, certain that the filings on it aggregating 237,378 miner's inches or 4,748 cubic feet per second are in excess even of its flood flow. The same may be said of its tributaries. On the Arroyo Seco we find claims, eliminating as above all duplications and refilings, for 204,550 inches or 4,091 cubic feet per second, on the San Lorenzo 11,500 inches or 230 cubic feet per second, and on the San Antonio for

10,000 inches or 200 cubic feet per second. An examination of all existing works on the Salinas and its tributaries shows that the actual capacity of the works having filings for taking water is about as given below. The total claims on each stream are repeated here for comparison:

Claims to Salinas River and tributaries and capacity of diverting works.

Stream.	Capacity of canals.		Claims.	
	Miner's inches.	Cubic feet per second.	Miner's inches.	Cubic feet per second.
Salinas River	64,665	1,293.5	237,378	4,748
Arroyo Seco	23,350	467.0	204,550	4,091
San Lorenzo	34,375	687.5	11,500	230
San Antonio	(*a*)	....	10,000	200

a Slight, not determinable.

The San Lorenzo is the only stream on which the filings are not in excess of the ditch capacity, and where on a single day the flood flow has been in excess of the filings. The information on this point was obtained through the courtesy of Mr. Morse, from the Spreckels Sugar Company. Mr. Morse had some determinations of the storm flow of San Lorenzo Creek made by Mr. Thompson, C. E., and supplemented these latter by gage readings on which approximate discharge calculations were based. On January 3, 1900, San Lorenzo Creek is said to have had a flood flow of 900 cubic feet per second.

The determination of the actual carrying capacity of existing works, except in the case of two pumping plants, had to be based on calculations, since no water was running through the ditches which take water by gravity from the Salinas and its tributaries when the examination was made. It is the intention to substitute the results of actual gagings if they can be made this coming spring.

From what has been said regarding the claims to the waters of this river and its tributaries, it is apparent that the present method of recording water claims is unsatisfactory, and is apt to work injury to everyone concerned. Under existing rulings "evidence as to the capacity of the flume and the amount of water used is evidence of appropriation," so that the amount claimed in the filing has nothing to do with the matter. Again, the point of diversion may be changed, if others are not injured by the change. (San Luis Water Co. *v.* Estrada, 117 Cal., 168.) There is no method of determining whether any claim has been made good except by field examination; and even then the point of diversion and place of use may have been changed, so that it may not be possible to trace a ditch back to the claim filed by its owners. This confusion is added to by the decisions of the supreme court, that the effect of posting the statutory notice and filing a copy of the same is merely to date the appropriation back to the time of posting the notice, and that an appropriation is just as valid if no notice is posted. (See Burrows *v.* Burrows, 82 Cal., 564, cited below.) The people of the Salinas Valley are fortunate in that the court records of Monterey County as yet contain but few water-right cases, and it is hoped that some better method of filing and proving up on claims will he devised before such difficulties arise.

STORAGE.

It has before been stated that the streams of the valley are practically torrential in character, and that to make their waters useful throughout the year the floods must be stored. Even should such storage be possible at a reasonable outlay per acre-foot of water, there is no legal protection to the builder of storage reservoirs unless the rights of all riparian owners below the point of storage are acquired.

It is evident from what has been stated above that the riparian law under which water cases are now decided is a serious obstacle in the way of irrigation development. It does not seem that anything short of its abolition and the substitution of an entirely different law can bring about a change for the better.

USE OF UNDERGROUND WATERS.

There are undoubtedly many parts of the valley for which irrigation by pumping from subsurface sources will be more economical than the construction and maintenance of long and large ditch lines, with the resultant large losses of water in transmission. The determination of the existence of such subsurface sources is therefore of great importance, and Mr. Nutter's report (see Appendix, p. 208) shows the extent to which our investigations were carried in this direction.

Irrigation by pumping is already practiced to some extent in the Salinas Valley, as shown in detail below. As pumping plants increase, a lowering of the subsurface water level will undoubtedly take place, interference of new wells with old ones will result, and lawsuits will follow. There are at present no methods by which a filing on subsurface water can be made unless an actual stream flowing between banks can be shown to exist. It certainly seems desirable that something should be done which will protect a man when he has established a pumping plant, and secure to him the permanent use of a definite amount of subsurface water. In New Hampshire this rule has been adopted in several decisions: "That a landowner's right to obstruct or divert oozing or percolating water is limited to such a quantity of water as is necessary for the reasonable use of his own land." That ruling raises the difficulty of deciding what constitutes "reasonable use," and in England, as well as in most States of the Union, this difficulty has been thought so great by the jurists deciding water cases that they have declared that there is no property in underground water. This whole question is treated in an admirable manner by Lord Robert Cecil, Q. C., in a paper entitled "The law of underground water," published in the Engineering Record December 2, 1899. He says:

> The law is clear. It is generally true that all that lies beneath the land belongs to the owner of the surface. To this rule water is the exception. There is no property in underground water. But, on the other hand, each owner may pump from his land what water he can get, with two exceptions: He must not directly or indirectly take water already contained in a surface stream, nor must he abstract water flowing underground in a known and definite channel. He has a perfect right to drain the supplies to all his neighbors' wells, however long they may have been enjoyed by their owners. So, too, he may pump till springs miles away have ceased to flow and threaten to become swallow holes for the streams they used to feed. Further than this he may not go. Once water is in the channel of a stream, above or under ground, it is safe from subterranean depredators.

This is, Lord Cecil believes, the law; "Whether it should be changed, and if so, how, is another story." The California decisions agree with the law as laid down above. (Gould *v.* Eaton, 111 Cal., 639; Hanson *v.* McCue, 42 Cal., 303; So. Pac.

R. R. Co. *v.* Dufour, 95 Cal., 615; Vineland Irr. Dis. *v.* Azusa Irr. Co., 126 Cal., 486.) There exists, therefore, to-day no legal protection for a man who has developed a subsurface supply.

DUTY OF WATER.

If, as intimated above, an attempt is made to legalize subsurface filings, and even for existing surface filings, it will be necessary to determine what is "reasonable use." In other words, the duty of water, i. e., the number of acres which 1 cubic foot per second flowing constantly for three hundred and sixty-five days in the year can irrigate, must be determined. One cubic foot per second is equal to 31,536,000 cubic feet per year. If we cover 1 acre, or 43,560 square feet, with 1 foot of water, the above quantity is sufficient to cover 724 acres, or the duty of 1 cubic foot per second would be said to be 724 acres. If we put 2 feet of water on the land, the duty of 1 cubic foot per second will be only 362 acres. It will at once be seen that this "duty of 1 cubic foot per second" must be a varying quantity, depending on the character of the soil, on climatic conditions, on kind of crop raised, on greater or less skill of the irrigator, on length of time water has been applied for irrigation in the vicinity, on subsurface drainage conditions, and many more factors. Nevertheless it will be possible in any given section of the State to determine within practical limits what may be considered the duty of 1 cubic foot per second of water in that section. Investigations in the Salinas Valley during the past summer, reported below, show that this duty runs all the way from 270 acres to 1,448 acres. Such a wide range is not found in the southern part of the State, where necessity has compelled an economical use of water. In Sweetwater Valley, Pomona, and Ontario the duty of 1 cubic foot per second is about 500 acres, while for all of California it may average not over 200 acres. A careful study of the factors mentioned above must be made to determine for the Salinas Valley what constitutes for its irrigators a "reasonable use" of water or "duty," which two terms ought to be synonymous from the irrigator's standpoint.

METHODS OF DISTRIBUTION.

As irrigation on a large scale in the Salinas Valley is comparatively recent, methods of distribution are still crude. No special care is taken in providing the consumer with exactly the quantity of water his contract calls for. As yet the water companies are extremely liberal in furnishing the "thorough" irrigation specified in the ordinance fixing rates. The following ordinances and water contract show the terms on which water is distributed in the Salinas Valley:

ORDINANCE NO. 294.

AN ORDINANCE to regulate and establish rates to be charged for the use of water in the county of Monterey, State of California, sold by the Soledad Land and Water Company, a corporation.

The board of supervisors of Monterey County do ordain as follows:

SECTION 1. The Soledad Land and Water Company, organized under the laws of the State of California, is hereby authorized and permitted to charge and receive for the use of water provided by and which may be sold by it in Monterey County, State of California, when not sold within the limits of any incorporated city or town in said county, the following tariff rates and amounts:

FOR IRRIGATION.

For each acre-inch of water measured at a weir in main ditch in canal nearest and above the land to be irrigated, 16⅔ cents; the land so irrigated to be first placed in a proper condition for irrigation by the landowner under such reasonable rules therefor as may be adopted by said corporation.

SEC. 2. The following rules are hereby established for use of said water:

First. Said company shall not be required to deliver water for irrigation of lands unless said lands are in proper condition to receive said water without waste or loss of water. Second. Said water shall be used by the consumer for no other purpose than the proper irrigation of the land when purchased for said purpose. Third. The water shall not be used or turned from the canal for irrigation or for any purpose by a consumer without first making application to the company or its agent to divert the same, nor shall said company be compelled to sell or deliver water to anyone indebted to the company for water until said indebtedness is fully paid, and from any delinquent consumer the company may require payment in advance of the delivery of any water. Fourth. For any violation of the above rules during the time of its delivery the water may be shut off and shall not be turned on again without satisfactory assurance of an intention on the part of the consumer to comply with the regulations herein stated.

SEC. 3. Nothing in this ordinance contained shall be construed to prohibit or invalidate any contract already made, or which shall hereafter be made, by or with said Soledad Land and Water Company, or any person, company, association, or corporation having or to have appropriated water for sale, rent, or distribution in Monterey County, relating to the sale, rental, or distribution of water, or to the sale, rental of easements, and servitude of the right to the flow and use of water, nor to prohibit or interfere with the vesting of rights under any such contract.

SEC. 4. This ordinance shall be in force and effect immediately.

ORDINANCE NO. 296.

AN ORDINANCE to fix and regulate the maximum rate at which the Spreckels Sugar Company, a corporation, may or shall sell, rent, or distribute water appropriated by said Spreckels Sugar Company, in the county of Monterey, State of California.

The board of supervisors of Monterey County, California, do ordain as follows:

SECTION 1. The Spreckels Sugar Company, a corporation organized and existing under and by virtue of the laws of the State of California, having or to have and hereafter appropriated water in the county of Monterey, State of California, for sale, rental, and distribution, is hereby authorized to sell, rent, and distribute the water appropriated by said Spreckels Sugar Company, in said Monterey County, when not sold within the limits of any incorporated city or town in said Monterey County, at a maximum rate of one dollar and fifty cents per acre for each irrigation of each and every acre of land irrigated by said Spreckels Sugar Company, the irrigation of said land to be according to the rules and regulations of said corporation.

SEC. 2. Nothing in this ordinance contained shall be construed to prohibit or invalidate any contract already made or which shall hereafter be made by or with the said Spreckels Sugar Company, or any person, company, association, or corporation having or to have appropriated water for sale, rental, or distribution in Monterey County, relating to the sale, rental, or distribution of water, or to the sale of easements or servitudes of the right to the flow and use of water; nor to prohibit or interfere with the vesting of rights under any such contract.

SEC. 3. This ordinance shall be in force and effect immediately.

CONTRACT.

To the Salinas Valley Water Company, Kings City, Cal.

GENTLEMEN: I hereby apply to your company for water to irrigate the following-described lands situated in Monterey County, California, to wit, ——— ———, containing —— acres.

I agree to prepare the said land in proper manner for irrigation (under your supervision) and also agree to use the water with all reasonable economy and at the time or times when you shall furnish same, provided, however, that you furnish it between the —— day of ———, A. D. 189-, and the —— day of ———, A. D. 189-; and I agree to have my land ready to irrigate at all times between said dates; and I agree to pay the sum of $——— per acre for the said land to the said company, provided said company is prepared to furnish sufficient water to properly irrigate said lands between said dates.

Signed, sealed, and delivered in the presence of—

——— ———. [Seal.]
——— ———. [Seal.]

——— ———.

It is evident that transactions based on such vague terms can not, in the long run, be satisfactory to either party. Provision must be made in the Salinas Valley, as elsewhere, for a form of contract under which payment is made for the quantity of water used, and under which contract the quantity must be actually measured out to the consumer in some reasonably accurate manner. The tenants of the Spreckels Sugar Company are not charged for water that runs through the factory, but they are charged $1.50 per acre when the water has to be pumped directly for irrigation.

IRRIGATION IN THE SALINAS VALLEY.

Below are given abstracts of statements made by the owners of irrigation plants in the Salinas Valley:

Henry Bardin. Lot 8, Cocks Tract Rancho. Two 10-inch wells, 20 feet apart, 190 and 196 feet deep. Pumping lowers water level 20 to 22 feet. Pump, 8-inch centrifugal. Irrigates by flooding 6 inches deep. Checks, 60 by 70 yards. Irrigated 45 acres of alfalfa at a cost of $2 per acre. Irrigates after each crop. Soil, sediment and sandy loam. Surface water at 6 feet. Does not know whether it pays or not.

J. G. Armstrong. On E. ½ of the SE. ¼ of sec. 26, T. 14 S., R. 2 E., M. D. M. Two 10-inch wells, 197 feet deep, water rising to within 1.5 feet of surface of the ground. Pumping lowers water level 12 to 14 feet. Gravel at 115 feet. Pump, 8-inch centrifugal, throwing 2,000 gallons per minute. Irrigates by flooding 8 inches deep. Irrigated 80 acres of alfalfa for self and 300 acres for neighbors, at a cost of $1 per acre. Soil, sediment and sandy loam. Ditch, 2 feet on bottom, 4 feet on top, and 3 feet deep. Surface water at 6 feet.

On lot 5, Las Salinas Rancho. From river. Pump, 10-inch centrifugal. Irrigated 70 acres of alfalfa and rye grass.

At dairy on the Monterey City lands. Four 10-inch wells. Pump, 6-inch centrifugal. Irrigated 90 acres. Land doubled in value. "Money in it."

Frank McFadden. El Tucho Rancho. Two sets of 10-inch wells. First set 178 and 187 feet deep, water rising to within 5 feet of surface of ground; second set 194 and 196 feet deep, water rising to within 7 feet of surface of ground. Pumping lowers water 14 to 15 feet. Pump, 8-inch centrifugal, throwing 1,500 gallons per minute. Irrigates by flooding 6 to 8 inches deep. Irrigated 20 acres of alfalfa. Can irrigate 365 acres of farming land. Good irrigation lasts two years. Cost, $3 per acre. Soil, sediment and sandy loam. Surface water at 14 feet. Increase of value of land, 25 per cent.

S. M. Black. On sec. 22, T. 14 S., R. 2 E., M. D. M. Two 10-inch wells 25 feet apart, 203 feet deep, water rising to within 7 feet of surface of ground. Pumping lowers water level 12 feet. Surface water at 17 feet; first water at 161 feet. Water-bearing gravel from 180 to 203 feet. Pump, 8-inch, throwing 1,600 to 1,700 gallons per minute. Irrigated 50 acres of beets and 60 acres of summer crop at a cost of $3.50 per acre. Irrigates 4¼ acres in twelve hours, wetting ground 4 feet deep. Soil, sediment and sandy loam. Increase of value of land, 25 per cent. Increases crop two or three times. "Good thing."

Breschini. Las Salinas Rancho. From river. Pump, 5-inch, running at 500 revolutions per minute. Irrigated 500 acres of alfalfa, using canvas hose and allowing water to flow over the land. Results very poor.

Benjamin Hitchcock. Lot 42, Nacional Rancho. Two 10-inch wells 200 feet deep, water rising to within 16 feet of surface of ground. Pumping lowers water level 15 feet. Thirty to 35 feet of gravel. Pump, 8-inch, throwing 1,500 to 1,700 gallons per minute. Irrigated 35 acres of summer crop, 35 acres of standing grain (result poor), 15 acres grain by flooding; water 6 inches deep. Whole ranch can be irrigated. Cost, $2.50 per acre. Irrigated eighteen days. Soil, adobe and sandy loam. Increase in value of land, 25 per cent.

H. L. Davis. Lots 46, 47, and 48, Nacional Rancho. Two 10-inch wells, 150 and 151 feet deep; water rising to within 10 feet of surface of ground. Pumping lowers water surface 4 feet. Pump, 8-inch, throwing 2,000 gallons per minute. Irrigated 387 acres of beets and potatoes 20 inches deep in 3.5 months, at a cost of $3 per acre. Soil, sediment and sandy loam. Increase in value of land, 25 per cent.

John Daugherty. Lot 37, Nacional Rancho. One 7-inch well, 176 feet deep; water rising to within 6 feet of surface of ground. Pumping lowers water level 9 feet. Pump, 4-inch centrifugal. Irrigated 20 acres of alfalfa 6 inches deep in six weeks. Soil, adobe.

C. E. Brown. Lot 1, Buena Vista Rancho. From river. Pump, 8-inch, throwing 2,000 gallons per minute. Eighteen-horsepower engine, burning wood. Irrigated 12 acres of alfalfa and 13 acres of potatoes, 6 acres a day 8 inches deep, at a cost of $3 per day for fuel, running engine himself. Bottom land.

Thomas Chappel. Lot 11, Guadalupe Rancho. Two 10-inch wells, 126 feet deep; water rising to within 8 feet of surface of ground. Pumping lowers water level 10 feet. Pump, 8-inch centrifugal, throwing 1,500 to 2,000 gallons per minute. Irrigated 85 acres 6 inches deep. Checks and hose. Cost, $7 or $8 per acre. Can irrigate 250 acres of land. Soil, sandy loam. Increase in value of land, 25 per cent.

Miller. On Ignacio Malarin place, Guadalupe Rancho. Two 10-inch wells, 125 and 130 feet deep; water rising to within 6 feet of surface of ground. Pumping lowers water level 13 feet. Pump, 8-inch centrifugal. Irrigated 60 acres of alfalfa 6 inches deep in about forty-five days, at a cost of $2.50 per acre. Soil, sandy loam.

From river. Same pump irrigated 3 or 4 acres in four days.

Salvation Army Colony. Lot 4, Soledad Rancho. From river. Pump, 16-inch centrifugal, throwing 8,000 gallons per minute. Eighty-horsepower Frick engine. Irrigated 200 acres for three months 2 to 12 inches deep. Irrigated 8 acres in twelve hours. Burn 3 cords of green wood, cost $3.75 per cord; 1½ cords dry wood give same amount of steam. Ordinary run, 5,000 gallons per minute. Capacity, 10,000 gallons per minute, but flume can not carry. Actual flow, measured in flume July 27, 4,940 gallons per minute. Suction, 14.5 feet. Can irrigate 300 acres more. Soil, sandy loam. Practically no crops for last seven years. This year good crops where water has been put on. Ditches 4 feet on bottom, 6 feet on top, and 3 feet deep; fall, 1 to 1,000.

Soledad Land and Water Company. Lot 3, Soledad Rancho. From river. Delivered at pump by ditch. One 20-inch Krogh centrifugal pump, throwing 10,000 gallons per minute, with a 15-foot lift. Irrigated 650 acres in seventy days of eleven hours 12 inches deep. Have irrigated for five seasons. Practically whole tract can be irrigated. Charge, $1.50 for 9 acre-inches. Soil, sandy loam. Ditches 6 feet on bottom, 9 feet on top, and 3 feet deep; fall, 1 to 1,000.

Gonzales Water Company. From river. Ditch at mouth 30 feet on bottom, 40 feet on top, and 6 feet deep. Drops to 25 feet on bottom, 35 feet on top, and 6 feet deep; fall, 1 to 5,000. Seven miles of ditch (main). Irrigated for A. Gonzales 1,300 acres. Can irrigate 300 acres more. Irrigated for Dr. Gonzales 900 acres; irrigated for M. Williams, 300 acres. Can irrigate from present ditch, Badsasci 200 acres, Lanini 200 acres, Bradbury 300 acres, Doud 100 acres. No charge this year. Next year $1.50 per acre for "thorough irrigation."

Doud. Lot 6 A, San Vicente Rancho. Three 10-inch wells, 250, 232, and 184 feet deep; water rising to within 30 feet of surface of ground. Pumping lowers water level 9 feet. At first lowered it 13 feet. Twenty-five feet of gravel. Pump, 10-inch Jackson, throwing 4,000 gallons per minute. Eighty-horsepower engine. Irrigated 120 acres 6 inches deep first irrigation, and 4 inches deep second irrigation. Cost, $2 per acre. Irrigates one hundred and twenty days of twelve hours. Soil, adobe.

McFadden & Storm, on Vierra place. One hundred and ten acres beets from McFadden plant.

Vierra. Fourteen acres alfalfa and potatoes from McFadden plant.

Spreckels Sugar Company. Ranch No. 1. From river two 18-inch pumps on bridge, throwing 10,000 gallons per minute each.

PLATE XIX.

IRRIGATION SCENES ALONG THE SALINAS RIVER

INTAKE CANAL - SALVATION ARMY COLONY

DISTRIBUTION BOX - SOLEDAD LAND AND WATER COMPANY

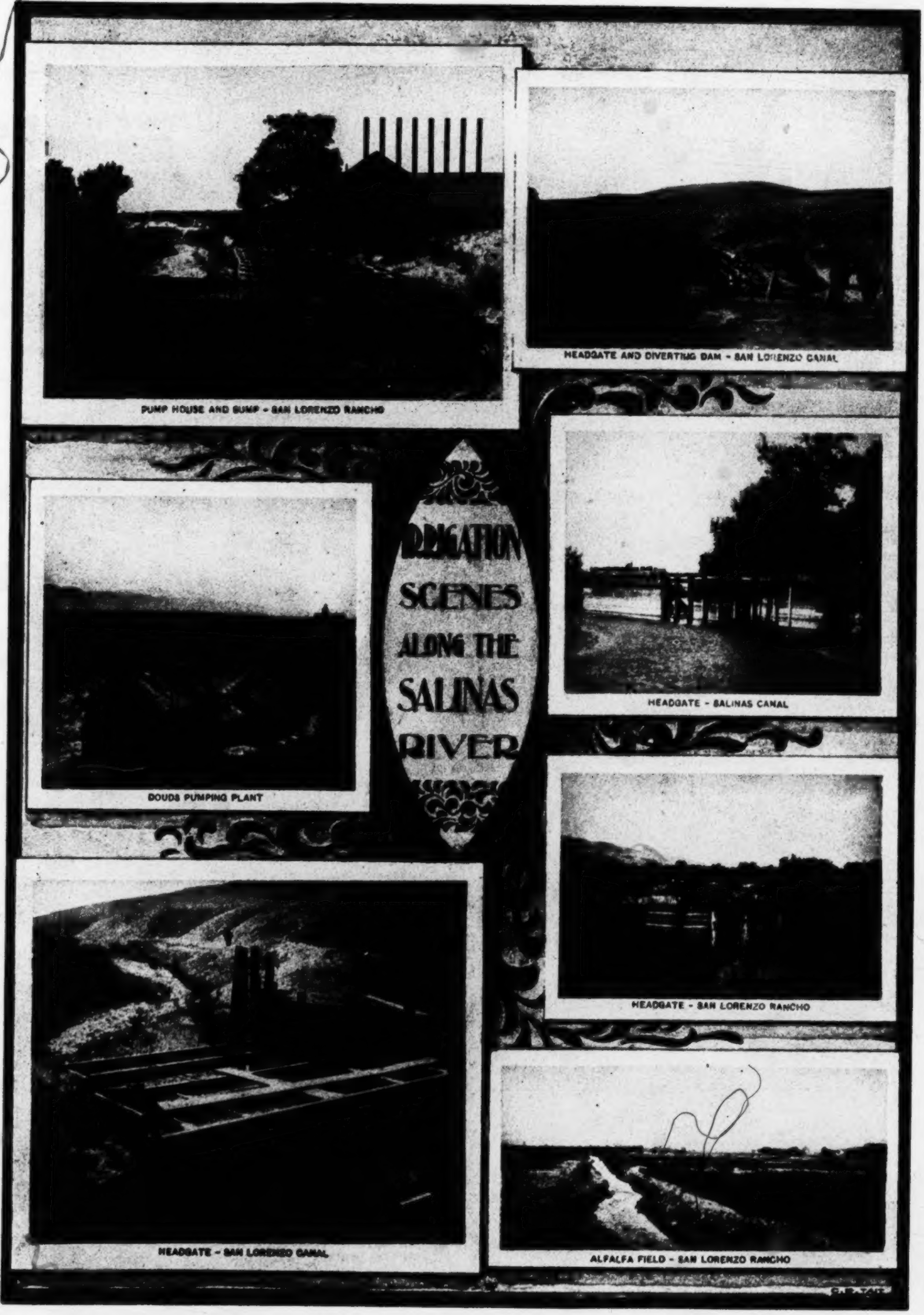
THE SALINAS RIVER AND BRANDENSTEINS DAM

PUMPING STATION AND FLUME-SALVATION ARMY COLONY

HEADGATE - GONZALEZ WATER COMPANY

IRRIGATION - SOLEDAD LAND AND WATER COMPANY

BRANDENSTEINS DITCH



IRRIGATION SCENES ALONG THE SALINAS RIVER

PUMP HOUSE AND SUMP - SAN LORENZO RANCHO

HEADGATE AND DIVERTING DAM - SAN LORENZO CANAL

DOUDS PUMPING PLANT

HEADGATE - SALINAS CANAL

HEADGATE - SAN LORENZO RANCHO

HEADGATE - SAN LORENZO CANAL

ALFALFA FIELD - SAN LORENZO RANCHO

Irrigation by factory waste water, Spreckels Sugar Company, Ranch No. 1, season 1899–1900.

Date.	Acres irrigated.	Depth flooded.	Acre-feet.
Week ending—		*Inches.*	
September 16, 1899	55	....	....
September 23, 1899	75	....	....
September 30, 1899	60	....	....
October 7, 1899	75	....	....
October 14, 1899	110	....	....
October 21, 1899	100	24	199
October 28, 1899	75	22	136.7
November 4, 1899	145	19	231.7
November 11, 1899	110	20	185.1
November 25, 1899	30	25	62.7
December 2, 1899	22	32	58.7
December 9, 1899	140	24	278
December 16, 1899	28	24	56.3
December 30, 1899	75	29	180.7
January 6, 1900	53	18	79.5
February 3, 1900	42	20	68.9
February 10, 1900	121	19	194
Total	1,316	....	1,731.3

Water supply, five 46-inch wells, 160 feet deep; water rises to within 4 feet of surface of ground. Pumps, two 12-inch centrifugal, throwing 3,500 gallons per minute each. Both pumps lower water level 19 feet. Forty feet of gravel to bottom of well.

Willoughby tract. From Salinas River.

Irrigation on Willoughby Tract, Spreckles Sugar Company Ranch No. 1, season 1899–1900.

Date.	Acres irrigated.	Depth flooded to nearest inch.	Acre-feet.
Week ending—			
March 31, 1900	32	18	48.5
April 7, 1900	63	15	79.4
April 14, 1900	61	16	83.0
April 21, 1900	50	17	70.5
April 28, 1900	44	20	73.9
May 5, 1900	56	17	80.6
May 12, 1900	50	....	....
Total	356	....	435.9

M. Williams. Lot 7 B, San Vicente Rancho. Three 10-inch wells 110 feet deep. Water rises to within 4 feet of the surface of the ground. Pumping lowers water level 12 feet. In gravel 30 feet. Pump 8-inch Krogh, throwing 1,500 gallons per minute. Lift of 16 feet above pump. Irrigated 40 acres of alfalfa 12 inches deep at a cost of $3 per acre. Can irrigate 500 acres from pump. Irrigated 200 acres from Gonzales Water Company's Ditch. Soil sandy loam and river bottom.

Salinas Valley Water Company. Arroyo Seco Canal number 1. Twenty-five feet wide, grade 8 feet to the mile. No irrigation.

Arroyo Seco Canal number 2. Top 30 feet, bottom 20 feet, depth 5 feet, grade 5 feet to the mile. Irrigated 2,600 acres.

Salinas Canal. Top 40 feet, bottom 30 feet, depth 5 feet, grade 6 inches to the mile. Irrigated, season of 1900, 2,000 acres.

San Lorenzo Canal. Top 30 feet, bottom 20 feet, depth 5 feet, grade about 12 feet to the mile.

Irrigated, season of 1900, 260 acres. Period of irrigation from November to June. Charges $1.50 for each irrigation. Contract lien on crop and money payable directly after irrigation, otherwise interest charged. Twelve inches of water sufficient. Alfalfa 4 crops, 2 wettings, 3 tons to the acre.

Spreckles Sugar Company, Kings City. Three 10-inch wells, 79, 80, and 81 feet deep, and 24 feet apart. Water rises to within 8 feet of surface of the ground. Pumping lowers water level 23 feet. Pump in pit 8 feet deep, and throws 13,000 gallons per hour. Pump 24 hours per day. Irrigate 4½ acres per day, using contour checks. Cut 4 crops of alfalfa, 2 to 3 tons per acre, and irrigate after every crop. Surface water in adobe at 21 feet. Irrigation wets down 12 feet. Can irrigate 12,270 acres. Irrigated by Salinas Valley Water Company from Salinas Canal, 20 acres; from San Lorenzo Canal, 1,200 acres.

Plant on river at the Kings City Bridge. Can pump 60,000 gallons per minute with a 48-foot lift. Burn 15 to 18 cords of willow and cottonwood per day, cost $1.40 per cord; will cost $3.50 or $4 per cord. Irrigate by checks 22 inches high, 50 by 60 feet. Soil, sediment. Can irrigate 2,000 acres. One irrigation in winter sufficient for grain or beets.

CASES ON IRRIGATION AND WATER RIGHTS ARISING IN THE COUNTIES OF MONTEREY, SAN BENITO, AND SAN LUIS OBISPO, DECIDED BY THE CALIFORNIA SUPREME COURT.

As was said before, there has been little water-right litigation in the Salinas Valley. The cases decided, with the exception of two already cited, involve no general irrigation questions. In Burrows *v.* Burrows the court held that the failure to post a notice does not invalidate an appropriation. In San Luis Water Company *v.* Estrada it was held that an appropriator can change the point of his diversion. Below are given the syllabi of the decisions in the irrigation cases arising in the valley.

ZIMMLER v. SAN LUIS WATER COMPANY.

(57 Cal., 221.)

Facts.—Plaintiff's intestate was a riparian owner on San Luis Obispo Creek, and as such diverted part of the water for irrigating his land. Defendant relied upon a deed from plaintiff's intestate which recited that whereas parties of second part were about to divert the water of San Luis Obispo Creek for the purpose of supplying San Luis Obispo with water, therefore party of first part granted "the right to convey water in iron pipes over and across the lands of the said party of the first part." Defendant claimed that this acted as an estoppel.

Held.—There is no direct grant of water. The plaintiff's intestate did not admit the right of defendant to divert the water. Therefore plaintiff is not estopped from denying defendant's right. If the recital had been that defendant had diverted the water, the case would have been different and there might be an estoppel.

GREEN v. CAROTTA.

(72 Cal., 267.)

Facts.—Plaintiff brought an action to perpetually enjoin defendants from disturbing the flow of an alleged natural stream. Originally the water was contained in a lagoon on defendants' land. More than ten years before suit a former owner of both parcels cut a ditch for the purpose of drainage and irrigation. Defendants used all of such water adversely to the whole world, except some which they allowed to go to waste. No adverse claim was set up against them for more than ten years prior to the action. The ditch ran to the border of plaintiff's land, and plaintiff had used the waste water by leave of defendants, not in writing.

Held.—Defendants owned the water absolutely. Therefore plaintiff never acquired any riparian right. His license was revocable at any time.

BURROWS v. BURROWS.

(82 Cal., 564.)

Facts.—In 1877 defendant dug a ditch and appropriated the waters of Muddy Creek, which was then on the public domain, and used them for domestic and irrigating purposes. He failed, however, to post the notice required by section 1415 of the Civil Code. In 1883 plaintiff gained title to land on the creek from the United States. At most seasons there was enough water for all parties, but for a portion of the year there was not. The lower court held that the water should be divided during the dry season. Plaintiff disputed the validity of defendant's appropriation.

Held.—Defendant's appropriation was valid. The failure to post the notice did not make it invalid. The object of the notice is to allow the appropriator to take advantage of the doctrine of relation. The court intimated that the lower court went too far in dividing the water, but as defendant did not complain the judgment was affirmed.

SMITH v. CORBIT.

(116 Cal., 587.)

Facts.—Mrs. M. had a parcel of land on which a stream had its source and flowed for some distance. She used the water for domestic and irrigating purposes. She conveyed one parcel to D, who from the time of his purchase used one-half of the water for the above purposes. Later he sold to plaintiffs who continued the use. Mrs. M. sold another parcel above plaintiff's to defendant. He used part of the water for the same purposes. There was a dam on his land which had been put there by Mrs. M. He moved the point of diversion higher up the stream. In 1894 the stream was not full enough to supply defendant's diversion, and consequently he took nearly all of the water, but did not waste any.

Held.—Plaintiff is entitled to recover. By her grant Mrs. M. gave him an easement. "The general rule of law is that when a party grants a thing he, by implication, grants whatever is incident to it and necessary to its beneficial enjoyment." Mrs. M. had used the water for the purposes for which plaintiff used it and must be presumed to have granted a right to the water which was reasonably necessary. That this was the intention was shown by her acquiesence in plaintiff's user.

Defendant had a right to change the place of diversion, provided he did not injuriously affect the rights of others. It did not entitle him to more than one-half the water of the stream, however.

Aside from plaintiff's easement, both parties were entitled to have their natural wants supplied before any water could be used for irrigation. After that each would be entitled to a reasonable use for irrigation. The court might therefore apportion the flow by periods of time.

SAN LUIS WATER COMPANY v. ESTRADA.

(117 Cal., 168.)

Facts.—Plaintiff was a corporation formed to furnish water to San Luis Obispo. In 1870 defendant Estrada, a riparian owner on San Luis Obispo Creek above the point of plaintiff's diversion, used the water for domestic purposes. The grantors of other defendants about the same time used the water for domestic purposes and for the purpose of running a mill. In 1872 plaintiff's grantor was given a franchise to supply water, and in 1875 it was transferred to plaintiffs. Plaintiffs diverted about 500,000 gallons per day. Later the defendant Estrada used the water for irrigating 35 acres adversely to everybody, except two of the other defendants who owned farther up the stream. The other defendants also used the water for irrigation. The lower court held that plaintiff was entitiled to 500,000 gallons daily. Estrada was entitled, except as against other defendants, to divert at a certain place as much as he had been taking. Jones and Moreland were entitled to use the water for domestic purposes, and after plaintiff had taken 500,000 gallons to use it for irrigation. An injunction was granted.

Held.—The decision of the lower court was correct, except as to the point at which Estrada could divert. He was entitled to change the point of diversion, if by so doing he would not injure the rights of others.

The transfer of the franchise to the corporation was not unconstitutional.

Evidence as to the capacity of the flume and the amount of water used is evidence of appropriation.

The necessities of the town can not increase plaintiff's right.

Plaintiff had a right to appropriate what was left after the use by the riparian owners in 1875.

Plaintiff relies upon appropriation and therefore arguments against title by adverse use do not apply.

Where plaintiff accepted an assignment of a lease of the lands upon which a defendant was using a water right, such lease is admissible in evidence as tending to show that plaintiff did not own such water right, and as tending to admit defendant's right thereto.

SUMMARY.

As a result of the preceding study of irrigation conditions in the Salinas Valley, it is now possible to answer the questions laid before the advisory board of engineers, and I think the conclusions reached will recommend themselves to the people of California. The questions were—

1. Is the present method of filing and recording claims to water satisfactory? If not, what should take its place?

Answer.—The present method is not satisfactory. Any system which it may seem desirable to recommend to take the place of the present lack of system must necessarily be based on our knowledge of certain physical facts. If these facts have not been obtained as yet, are not of record, or defective when of record, then it seems that the first attention should be turned to the collecting and digesting of this necessary material. As even such data as are to be had are widely scattered in different localities, it follows that there must be some central authority to which all this material must go.

2. Is the present method of adjudicating rights satisfactory? If not, what should replace it?

Answer.—It is not. It can not be until the necessary data on which to base an equable decision are available. If a board be established to take charge of those data, it would be naturally best qualified to render an equable decision, and should be made up with this end in view.

3. Is there any method by which the owner of a tract of land can acquire directly from the public a right to the water which reclaims that land, as he can now obtain title to the public land itself by means of the desert or homestead law? If not, should there be legislation to provide for this?

Answer.—There should be legislation to provide for this and use of the water should attach to the land.

4. What has been the influence of the doctrine of riparian rights on the success of irrigation, and what modifications of this doctrine are suggested?

Answer.—The doctrine of riparian rights has been harmful to irrigation development, and the California riparian law should be repealed.

5. Is the present system of stream control and of division of water satisfactory?

Answer.—It is not. The same central board, to the creation of which reference has been made, could put this matter in charge of an executive officer.

6. Should there be a State engineer, and what should be his duties?

Answer.—There need be no State engineer for this particular purpose if the board of control appoints as its executive officer a man of wide experience in the construction and management of irrigation works. Physical data are now being collected in a satisfactory manner by the National Government, and by suitable cooperation on the part of the State of California the national work can be sufficiently enlarged in scope to gather the necessary physical data. The duties of the executive officer would therefore be largely supervisory and advisory. All plans for new irrigation works should be submitted to the board of control, and after approval the executive officer of the board should see that they are carried out as approved. The executive officer of the board of control should also present to the latter the facts on which to base its decisions in cases of dispute, and should see that the decisions of the board are carried out.

7. Should there be a central office of record of claims or titles to water in place of the present separate county records, and what supervision or control should be exercised over rights to be acquired hereafter?

Answer.—There should be a central office, and the board of control already referred to should have the determination of existing rights and the control of the establishment of rights hereafter.

8. What steps should be taken to secure the fullest conservation and use of water which now runs to waste? The discussion of this question to include State or National control and aid, the legislation needed to define rights to stored water, and to determine who is entitled to the waters thus stored.

Answer.—There should be cooperation and consultation between the State and National governments looking to the fullest possible use of the waters of the State for irrigation, with especial reference to Sacramento and San Joaquin rivers. The work of the National Government should include: (*a*) Improvement of the rivers;

(*b*) protection of the forests; (*c*) aid in the adoption of better methods of irrigation, as the work now being done by the Department of Agriculture; (*d*) collection of accurate stream-flow and run-off data; and (*e*) storage of waters for the public lands.

It has already been stated that special legislation is needed to define rights to stored waters, as at present these rights are vested in the riparian owners.

APPENDIX.

WATER-BEARING GRAVELS AND FORMATIONS TRIBUTARY TO THE UNDERGROUND WATER SUPPLY OF THE SALINAS VALLEY IN MONTEREY COUNTY.

By Edward H. Nutter.

In June and July, 1900, under the direction of Dr. J. C. Branner, Mr. L. D. Mills and I undertook to trace out and map the formations in Monterey County which appear to bear directly on the underground water supply of the Salinas Valley. The work was done by Mr. Mills and myself, working together from June 4 to June 28, at which date Mr. Mills left, and the remainder of the work was done by me without assistance.

A general outline of the geological structure and history will perhaps serve to make clearer the bearing of any details which may be given below.

From Doud northwest the Salinas Valley is carved in granite and other crystalline rocks, while the southern portion is cut in gently sloping beds of marine Pliocene sediments. These beds, if they extend into the northern end of the valley, have been completely buried by material which has been washed in from the hills and mountains on both sides of the valley, and which has been spread out in the form of very large alluvial cones or fans. Going southward from the district characterized by these fans, the Pliocene gravels begin to crop out from beneath the talus at Riverbank and at a point about one mile south of the Salvation Army Colony, and gradually rise until at Kings City they form a series of beds that extend eastward about eighteen miles from the Salinas River. From Kings City to the San Luis Obispo County line these same beds form the southeastern escarpment of the immediate valley, with an average height of about 100 feet above the river. For the most part these Pliocene beds overlie Miocene sediment, but in some places they are on the

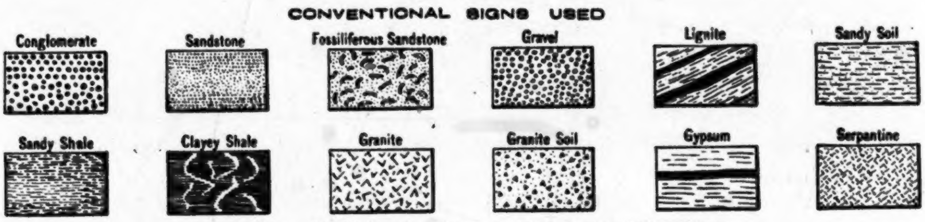


FIG. 5.—Conventional signs used in illustrating report on Salinas River.

older rock. The ages of these Pliocene and Miocene beds were fixed from fossils found in them, which were identified by Mr. Ralph Arnold, of Stanford University. The Pliocene fossils were found in sandstone about 20 miles southeast of Monterey City, in sec. 20, T. 6 S., R. 3 E., M. D. M. The beds in which they occur are apparently the same as those east of Kings City. The Miocene fossils were from shale beds outcropping on the west side of the Salinas River at Wunpost.

In the southern part of the county there have been at least two general elevations of the land surface, for the Pliocene gravels forming the large terrace are to a great extent composed of shale pebbles, and these same beds have been tilted and are conformable with beds of shale.

The partings between the rock in place and the gravels and other alluvial material were traced from a point about 2½ miles east of St. Joseph's Colony, in sec. 18, T. 15 S., R. 5 E., in a general southeasterly direction, to the southwest corner of T. 18 S., R. 8 E., and from Lonoak on the San Lorenzo River in a general southeasterly direction through the Peach Tree, Slacks Canyon, and Cholame Valley country to Parkfield. They were also traced from Pleyto, in T. 24 S., R. 9 E., around the San Antonio Valley, and to some extent in the Nacimiento River country. Also from the San Luis Obispo County line the partings were traced around Hames Valley to Wunpost Station, thence in a general northwesterly direction to a point about 2 miles south of Spreckels' beet-sugar factory, thence southward to sec. 21, T. 16 S., R. 3 E.

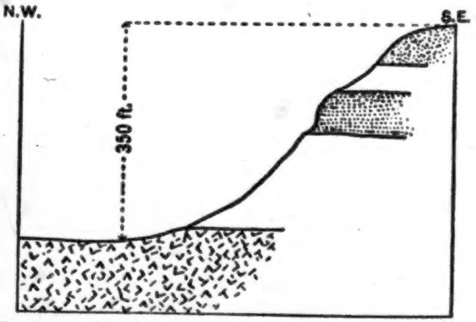


FIG. 6.—Outcrop of beds in terrace immediately south of head of Salinas Valley Water Company's irrigating ditch on the San Lorenzo River.

Beginning at about the southwest corner of T. 18 S., R. 8 E., is the terrace or upland, formed of the marine Pliocene beds already mentioned. At the head of the Salinas Valley Water Company's irrigating ditch on the San Lorenzo River the terrace is formed of beds of coarse and fine sandstone and flinty conglomerate. (Fig. 6.)

The fact that these beds are hardened into sandstones and conglomerate at this and some other points led to the supposition that the line between the terrace and the valley lowland marked the easternmost limit of the water-bearing gravels, and consequently this line was traced. Data subsequently collected seemed to show, however, that the lowest beds of this terrace, which are for the most part porous sands and gravels, extend under the Salinas Valley. It therefore seems certain that the terrace area is largely tributary to the underground water supply, and the eastern limit of this area was consequently traced out.

From the contact east of St. Josephs Colony to about River bank the rock in place is granite, mica schist, and gneiss, and the alluvial material which laps upon these rocks is a granite soil containing angular fragments of granite and schist. Occasionally, slightly rounded fragments, looking as though they had been water-worn, were found, but these were unusual. The feature of the topography between these points on both sides of the valley is the number of alluvial cones or fans, already mentioned, which spread out from the mouths of the canyons, which cones are themselves cut by smaller gulches. A rudely stratified earthy conglomerate, the pebbles of which are angular fragments of granite, schist, and gneiss, varying in size from sand grains to fragments the size of one's head, is usually found capping these fans. In this section of the valley also the smaller stream beds, as they approach the river, show few signs of recent erosion, where observed, as though the water had sunk away into the ground.

Beginning at Riverbank, on the northeastern side, and at a point about 1 mile south of the Salvation Army Colony, on the southwestern side of the valley, are to be found the first true gravels, the Pliocene beds already mentioned, consisting of well-rounded pebbles. At Riverbank they occur in stratified beds in railroad cuts, and at both places they underlie the granite soil above mentioned. Presumably these gravels extend under the valley from Soledad to Salinas at least, for apparently the same beds are exposed in a cut on the southwest side of the Salinas River opposite the sugar factory. From Riverbank to Metz the rocks in place are granite and other igneous rocks, shale, and crystalline limestone.

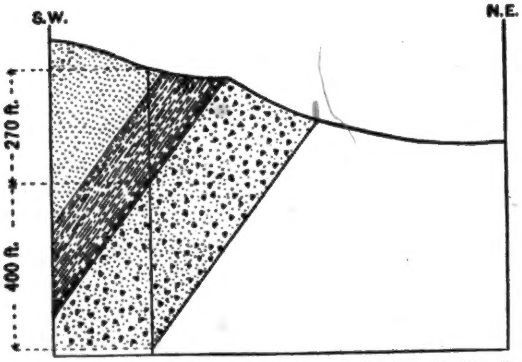


FIG. 7.—Sand and shale beds passed through by Barrett's oil well in southwest quarter section 31, T. 22 S., R. 14 E.

Beginning at the southwest corner of township 18 S., R. 8 E., and extending over the greater part of Topo Rancho and the Bitterwater country and southeast into San Luis Obispo County, is the Pliocene terrace. The northeastern edge of this terrace follows, for the most part, a series of anticlinal valleys extending in a northwest-southeast direction through the Peach Tree, Slacks Canyon, and Cholame country.

At Barretts Oil Well, in the southwest quarter of sec. 31, T. 22 S., R. 14 E., a large quantity of water was encountered in a bed of granitic sand at a depth of about 300 feet below the surface. (Fig. 7.)

In the bed of angular granitic sand more water flowed into the well than could be pumped out. Elevation at top of well is 1,870 feet above Kings City. Dip of shale is 54 degrees southwest. This suggests the possibility of artesian water being found in the Salinas Valley if wells were sunk to a sufficient depth. There are several folds between this well and the valley, however.

The beds forming the terrace are folded on each side of the Cholame Valley about Imusdale, but from about sec. 27, T. 23 S., R. 13 E., they dip at an angle of about 3 degrees toward the Salinas River. The distinguishing features of this terrace formation are the rather flat-topped hills, nearly all of which are in the same general plane, the large quantity of shale pebbles in the gravel beds, and the capping of rather loose sandstone containing enough lime to whiten it. These overlying limy sand beds occur at nearly all the places where the terrace formation was observed.

On the western side of the Salinas Valley, from the south boundary of Monterey County to near Paraiso Springs, the rock in place is shale. It is the same in the San Antonio and Nacimiento River valleys where traced.

In a cut on the Southern Pacific Railroad about 2 miles northwest of Bradley there is a good exposure of some of the beds of the terrace in an anticline. (Fig. 8.)

But few satisfactory well records were obtained. The first six of the following were furnished to Professor Marx by D'Arcy Porter, of Salinas City.

A 7-inch well in the river bottom near the factory of the Spreckels Sugar Company, 4 miles south of Salinas City:

From 1 foot to 11 feet, sediment, water; from 11 to 37 feet, blue sand; from 37 to 55 feet, blue sandy clay; from 55 to 80 feet, blue clay; from 80 to 92 feet, blue sandy clay; from 92 to 96 feet, blue sand; from 96 to 97 feet, small rocks; from 97 to 117 feet, blue fine gravel; from 117 to 134 feet, brown fine gravel; from 134 to 149 feet, coarse gravel; from 149 to 159 feet, coarse gravel and rocks, water; from 159 to 162 feet, yellow clay.

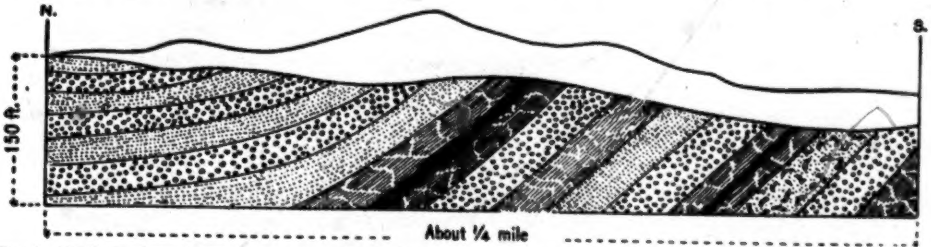


FIG. 8.—Northern slope of anticline cut by railroad 2 miles northwest of Bradley. The thin seam of lignite has gypsum mixed with it. The fossils are limpets, turritellas, and various clam and oyster shells.

A 10-inch well one-half mile from the ocean:

From 1 foot to 2 feet, adobe sediment, water at 4 feet; from 2 to 10 feet, blue sand; from 10 to 22 feet, blue clay; from 22 to 48 feet, fine gravel; from 48 to 63 feet, black hard clay; from 63 to 127 feet, fine gravel; from 127 to 131 feet, coarse gravel and rocks; from 131 to 135 feet, red, hard dry sand.

A well 7 inches in diameter, 9 miles east of Salinas and 1 mile southwest from the Gabilan Peak:

From 1 foot to 20 feet, red dirt and fine gravel; from 20 to 62 feet, red dirt and coarse gravel; from 62 to 95 feet, red clay and gravel; from 95 to 99 feet, coarse gravel; from 99 to 114 feet, yellow clay, water; from 114 to 135 feet, coarse gravel; from 135 to 137 feet, yellow clay.

A well in the city of Salinas:

From 1 foot to 6 feet, black loam sediment, water at 14 feet; from 6 to 22 feet, sediment; from 22 to 46 feet, yellow clay; from 46 to 48 feet, clay and gravel; from 48 to 65 feet, blue clay; from 65 to 77 feet, yellow clay and gravel; from 77 to 84 feet, coarse gravel, water; from 84 to 94 feet, fine gravel; from 94 to 147 feet, yellow clay; from 147 to 154 feet, fine gravel; from 154 to 229 feet, coarse gravel with rocks, water.

A well halfway between Salinas and Santa Rita:

From 1 foot to 84 feet, red dirt with a little gravel; from 84 to 90 feet, gravel, water; from 90 to 115 feet, yellow clay; from 115 to 216 feet, blue clay with clam shells and pieces of redwood.

A well 2 miles northeast of Santa Rita:

From 1 foot to 140 feet, red dirt and yellow clay; then went into a brown porous rock full of water, but did not go through it.

The following records are from data furnished by the owners of the wells, and were verified as much as possible by direct observation:

A well one-fourth mile southwest of Kings City was dug in yellow sand, and has water standing at about 40 feet from surface.

A well west of Kings City in NE. ¼ sec. 13, T. 20 S., R. 7 E., dug in shale. Water stands at 127 feet from surface, and is unfit for household use.

A well on Burchards Ranch, 4 miles east of Kings City:

From 1 foot to 20 feet, gravel, some water; from 20 to 86 feet, gravel and shale; from 86 to 141 feet, shale, sand, and gravel (fossiliferous); from 141 to 165 feet, clean yellow sand, water.

The elevation of this well is about 60 feet above Kings City.

A well in Hames Valley, near southeast corner of sec. 9, T. 24 S., R. 10 E., has water standing at about 130 feet from surface. Well is sunk in gravel. Water is unfit for household purposes.

No accurate observations of water levels in other wells were made, but in the wells of the Salinas Valley and of that portion of the above-mentioned terrace which lies nearest the valley the levels appear to correspond with the water level of the Salinas River.

CONCLUSIONS.

(1) For the most part the Salinas Valley in Monterey County is a trough that probably holds a great deal of water.

(2) The valley in its northern part, from near Doud to some point between Chualar and Salinas, is covered with talus washed in from existing mountains.

(3) Pliocene gravels and sands underlie this talus, though to what extent is uncertain. (Fig. 9.)

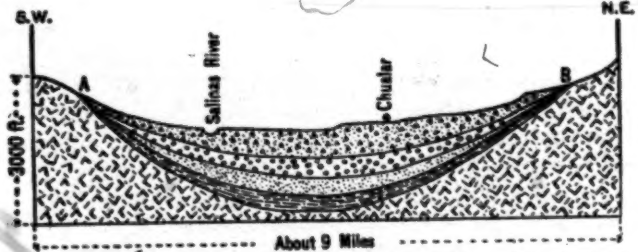


FIG. 9.—Probable structure of Salinas Valley on a northeast and southwest line through Chualar. A, B, observed structure.

(4) Going southward from Soledad, these Pliocene beds begin to rise from beneath the talus at about Riverbank, and a northeast-southwest section through Metz would be about as in fig. 10.

(5) From east of Kings City these beds form to the southward an extensive terrace, which continues into San Luis Obispo County, and which is probably tributary to the underground water supply of the Salinas Valley. (Fig. 11.)

A cross section through the terrace and Salinas Valley along any other line of the same general trend between this section and the county line would show substantially the same structure.

(6) In the drainage area of the San Antonio and Nacimiento rivers there are also Pliocene gravels which are indirectly tributary to the underground water supply of the Salinas Valley.

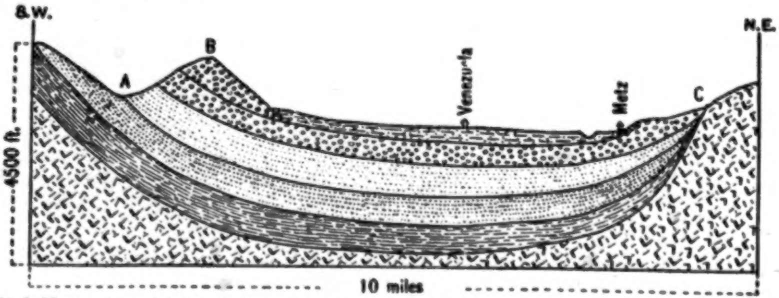

S.W.
B
A
Venezuela
Metz
C
N.E.
4500 ft.
10 miles

FIG. 10.—Probable structure of Salinas Valley on a line running through Metz and Venezuela. A, B, observed structure. Altitude of C=1,400 feet above Kings City. Dip of gravel bed at outcrop is 14° N. 20° E.

(7) It seems probable that deep wells put down near the margin of the Pliocene terrace, between Kings City and the San Luis Obispo County line, may yield considerable water, perhaps artesian.

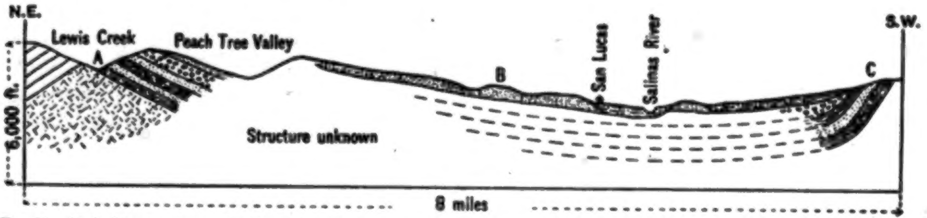

N.E.
Lewis Creek
A
Peach Tree Valley
6,000 ft.
Structure unknown
B
San Lucas
Salinas River
C
S.W.
8 miles

FIG. 11.—Probable structure of Salinas Valley and terrace containing marine fossils on a line running northeast-southwest through San Lucas. A, B, C, observed structure.

(8) It is possible that artesian water may be found in the region of the San Antonio and Nacimiento rivers, but not enough detailed work has been done there to warrant any definite conclusions upon the subject at present.

IRRIGATION FROM THE SAN JOAQUIN RIVER.

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INTRODUCTION.

It is now admitted by practically all intelligent citizens of California who have considered the matter that the subject of irrigation is the most important one ever brought forward for the consideration of all our people. They acknowledge, as a vital fact, that upon the complete development of her agricultural and horticultural capabilities must be founded her greatest and most enduring prosperity. The discovery of gold or petroleum may give to a State a feverish or fitful impetus; but her permanent position must ever be dependent upon the character and quantity of the products of her soil and her facilities for obtaining for them a good market. And when, as in every arid or semiarid region, the character and quantity of the soil products are directly dependent upon the application of water by irrigation, the development and conservation of the supply of this water is a vital consideration. As the water supply is found in the streams, they must be skillfully husbanded, and the forests, their birthplace, carefully preserved, if the lands cultivated are to attain their possible fertility and productiveness.

The forests and waters once conserved, both should be administered in the manner contributing in the greatest degree to the benefit of all; which is simply saying in the wisest and most economical manner. In California, as elsewhere, the projector of an irrigation enterprise should be made to feel secure in the possession of his water rights previous to expending his energies and fortune in such system. He should be able to hold as certain title to the use of the water for a beneficial purpose as is held to the land or property on which the water is used. Any doubt or uncertainty on this point affecting either jeopardizes both, for in many cases without water the land is worthless. If a capitalist believes that in embarking upon an irrigation venture he is buying a tedious and expensive lawsuit he is likely to seek other investment for his capital; and if a farmer be sure that every attempt to bring water upon his land will be met by some obscure claim of previous appropriation or ownership he will probably purchase a farm in some other locality.

In California, unfortunately, by a legal "tide-rip" between the riparian principle, brought over with the common law of England, and the right of appropriation of water established by our gold seekers and afterwards embodied in the civil code of our State, a stream of litigation, tempestuous and baffling to enterprise, was injected into our irrigation sea, bringing to the surface a great mass of very unpleasant matter.

That this condition of irrigation affairs should be reformed is the sincere wish of every thinking citizen of our State. With a code of water laws based upon fairness and justice to all, and an administration of them seeking the greatest good to the greatest number, not only would the irrigated districts but the whole State bound forward in a career of prosperity.

A BRIEF HISTORY OF THE DEVELOPMENT OF IRRIGATION IN CALIFORNIA AND IN THE SAN JOAQUIN VALLEY.

The problems to be discussed in this paper are those relating to irrigation from San Joaquin River and its tributaries. It seems best, before turning directly to them, to give a brief history of the development of irrigation in California and more particularly, in the San Joaquin Valley.

California, at first possessed by Spain and afterwards by Mexico, derived its earliest ideas and methods of irrigation from those countries. The first irrigation in the State was practiced by the Spanish mission fathers, who, while converting to Christianity and civilizing the Indians, planted and cultivated vineyards, orchards, and farms surrounding the missions. The methods of irrigation in Spain were peculiarly applicable to the coast region and interior valleys of California because of the similarity of natural conditions in the two countries.

Until the coming of the Americans the water laws of California were those of Mexico and Spain. Under them the waters of the stream were held to be a public trust, title to which could not be granted to any private person or corporation. Permission for use only could be given, and then to the actual user and to the amount used. Upon the discovery of gold in California in 1848 the miners took water from the streams to wash the golden sands, and established local laws dictated by common sense and the interests of their industry. As indicating their righteousness, it may be said that they were practically the same in all mining districts, however widely separated.

As time went on California, which had been at first almost exclusively a mining State, became a great agricultural one. Its valleys and hill slopes produced immense quantities of wheat and other cereals, and spots favored by nature were converted into wonderfully productive orchards and vineyards. Wherever within her boundaries the rainfall was ample and reliable crops were good, both in quality and quantity; but in many localities where the soil and sun were friendly the rainfall was uncertain and often deficient. Settlers in many cases realized the importance, and often the absolute necessity, of the artificial use of water upon their farms in order to secure crops and a livelihood.

The first attempts of the American farmer at irrigation resulted in works of the most primitive character. Often individual effort led to the introduction upon the land, through a plow furrow, of a small quantity of water from a neighboring stream. Later, communities of farmers cooperated and constructed irrigation canals, to be utilized in common. At first, of course, the water most readily obtained was made use of, and for a time only small, cheap systems were constructed, and elementary irrigation practiced.

As districts became more populous and the necessity for water greater, individual effort, and even local cooperation, became insufficient, both as to methods and capital, to supply the demand for water, and more costly and complicated irrigation systems were found to be necessary. Consequently stock companies were formed, and large amounts of capital enlisted in irrigation enterprises. In this way most of the waters flowing in the streams were "taken up" or "appropriated," and the importance of storage of the flood waters to meet the growing need became evident.

The development of stock companies and corporations soon grew to such proportions that a new danger became apparent. A monopoly of the waters available for irrigation was threatened. Great systems, involving the expenditure of hundreds of thousands of dollars or even millions, were practically absorbing all sources of water for irrigation. The farmers found themselves at the mercy of water companies, both as to rates charged and quantities of water applied; and the life and growth of agricultural communities were considered in jeopardy. This condition of affairs resulted in the evolution of the Wright irrigation law.

This law seeks to establish a system by which the people of any locality, the lands of which are capable of irrigation from a common source, may form an irrigation district on a basis somewhat similar to that of a municipal corporation. The effects of this law on irrigation in California and the litigation arising under it will be discussed later on.

During all this time the advantage of irrigation was becoming more firmly impressed upon California farmers and orchardists. With numerous excellent object lessons before them, they abandoned the prejudices formerly held against it and the expense and labor it involves, and have come to recognize in it an insurance not only of a crop but of vastly increased production from the same fields and, perhaps, of several harvests in a single year. As a result, from the more arid districts of southern California, where it naturally began, irrigation has spread rapidly over the State to its northern boundaries, and even over localities which are credited with reasonable rainfall.

Following closely in the path of such enterprise has come a wonderful increase in the variety and yields of crops, in population and in wealth. Raisins, wines, citrus, and other fruits have supplanted pastures, wheat, and barley; cities and towns stand on the ground of the old lonely farmhouse; and millions in bank are substituted for the "promise to pay" of unfortunate farmers. As an example of this wonderful increase in population, I will mention only seven of the many counties practicing irrigation, viz: Los Angeles, San Diego, San Bernardino, Kern, Tulare, Fresno, and Merced. In 1870 their total population was 40,849, and their combined wealth $22,513,820. In 1890 their population had increased to 296,719, and their wealth to $198,356,127; or the population had multiplied more than sevenfold and the wealth ninefold.

In contrast to these improved districts are those which have persistently resisted irrigation. They have not advanced. Often they have gone backward; and have retrograded in population and in wealth.

The writer believes that the prominence which California enjoys is largely due to irrigation; and that since the subsidence of the gold fever her progress and prosperity have been coincident with the production of the great variety and quantity of her crops resulting from the wise and skillful irrigation of her soil.

Turning now to the San Joaquin Valley, we find that Fresno County, in the center of the San Joaquin Valley, is, perhaps, one of the best illustrations in California of the benefits of irrigation and of the transformation which may be wrought by the wise and liberal use of water in irrigation. In 1871 a colony was established in that county which cultivated and irrigated vineyards, producing raisin grapes. Since that time the population has increased from a few hundreds to over 100,000 people, and now some of the most beautiful and productive orchards and vineyards in the whole State are to be found in that portion of the valley. More than twenty colonies have been established in the same locality, and nearly twenty main irrigation canals, having a length of about 800 miles have been constructed. Their branches have an aggregate length of about 2,000 miles. In this county alone nearly half a million acres are under cultivation; and this great area, which formerly was capable of producing only sparse crops of wheat, or pasturage for cattle, now markets immense crops of raisins, cereals, and alfalfa. The lands which formerly were of little value, are now, when irrigated, worth from $300 to $1,000 per acre. And like results in a measure have been obtained in every district in the San Joaquin Valley where ample and intelligent irrigation has been practiced.

From this small beginning has grown up a great system of canals in the San Joaquin Valley. Those drawing their waters from the San Joaquin River are the Aliso, Chowchilla, Blyth, and East Side canals, on the right, or easterly bank; and the James, the San Joaquin and Kings River Canal and Irrigation Company's canals, and the system belonging to Miller & Lux, on the left, or westerly bank.

Taking water from the Fresno River, one of the most important branches of the San Joaquin in the contiguous district, are the canals of the Madera Canal and Irrigation Company; and in the same section of the valley, the Sierra Vista Vineyard Company and the Bliss Canal draw their supplies from Chowchilla Creek, another tributary of the main river.

PHYSICAL FEATURES OF THE SAN JOAQUIN VALLEY.

THE SAN JOAQUIN RIVER.

The waters of San Joaquin River are the union of the streams from many creeks and branches in the high Sierras, fed by the rain and melting snow that fall upon a mountainous drainage area of 1,637 square miles. The summit range of the Sierra Nevada is the eastern boundary of this area, which extends northerly and southerly for more than 70 miles. The river flows down through a steep, rugged canyon, in a westerly direction, to its point of debouchment upon the open country at Pollasky (formerly Hamptonville), 27 miles northeast from Fresno. From this point it continues in a southwesterly direction for 55 miles to the trough of the San Joaquin Valley. Here it unites with the waters of Fresno Slough in a swampy region subject to overflow and turns sharply to the northwest. From this junction on to its mouth, near Antioch, a distance of 120 miles, it is the main river of the great valley, and receives the drainage of the latter from all the streams on either side. These are numerous, and some of them on the eastern flank of the valley, deriving their waters principally from the Sierra Nevada's rains and snows, are considerable in volume.

As a rule, these tributary streams from the Sierras lying north of the Upper San Joaquin run in deep beds for many miles below their exit from the mountains, and come to the level of the great plain only when nearing the trough of the valley. At this point in their course they turn northward and unite with the main stream—some as distinct branches; others, as in the case of the smaller ones, through swamps, sand-flat deltas, or overflowed tracts.

Those named below are the principal streams flowing down the east side of the valley, as enumerated from the northerly end, with the drainage area of each given. The streams marked with an asterisk derive their waters largely from the melting snows of the high Sierras. These snows are substitutes for extensive storage reservoirs, and slowly yield their waters throughout our early springs and summers—the irrigation season—in an unfailing supply of irrigation water. The remaining streams of the list have their sources in the nearer mountains and foothills, and are replenished by rains rather than by melting snows, and in consequence are torrential in character, intermittent in flow, and less reliable for purposes of irrigation.

Tributaries of the San Joaquin River, with their drainage areas.

	Square miles.
Consumne River*	589
Dry Creek	208
Mokelumne River*	573
Calaveras River*	390
Stanislaus River*	971
Tuolumne River*	1,514
Merced River*	1,072
Bear Creek	153
Mariposa Creek	96
Chowchilla Creek (or river)	272
Fresno Creek (or river)	258
San Joaquin River*	1,637
Kings River*	1,853
Keweah River	608
Tule River	446
Deer Creek	130
White River	96
Posa Creek	278
Kern River*	2,382
Caliente Creek	461
Numerous small streams	2,138
Total area of mountain and hill drainage	16,135

On the western slope of the San Joaquin Valley the streams originate in the Coast Range of mountains. They are torrential and intermittent in character. The stream beds carry water but a few hours or days after rainfall, and this water spreads over the upper plain, seldom reaching the San Joaquin. The streams are limited in supply and unreliable for irrigation.[1]

From Pollasky for a distance of 40 miles downstream the river winds along through low, fertile, and productive bottoms, shut in by bluffs, with hills behind them. The river gorge in this length varies from a mile to a half mile in width. Behind the bluffs and hills are elevated plains. These bluffs diminish in height above the river from 75 feet near Pollasky to 40 feet at Herndon, and finally disappear at a distance of 20 miles from that place, where the river runs into the Fresno Swamp delta.

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[1] William Hammond Hall.

The entire face of the valley trough surrounding the Fresno Swamp and the great bend of the San Joaquin River is often submerged during the floods, and below this region numerous sloughs break out from the San Joaquin, and, after running for a distance in the same general direction, reunite with it lower down, thus forming a broad, swampy area, often submerged and generally very fertile.

From Pollasky the river flows over alternating beds of disintegrating granite, interspersed with bowlders and coarse gravel and broad, flat bars of sand. Its channel varies in width from 300 to 900 feet, and also greatly according to the stage of the river. Its descent from Pollasky to the lower plains below Herndon is quite rapid, being more than 80 feet in the 20 miles. From this point its fall is naturally more gradual as it passes out upon the nearly level plains, being only 36 feet to its union with the waters of Fresno Slough, 36 miles farther down.

In its course through the valley trough the descent of the river is still more gradual, and in times of low water it winds along around sand bars in its bed or bordering its banks. For example, the straight line from the junction of the river with Fresno Slough to the head of Old River, where it separates into two channels, is 87 miles in length, but the river between those points develops into 146 miles. Its average width in this stretch is from 300 to 600 feet, and its depth from bank top to bed is 12 to 18 feet.

The river bed is usually covered with clean siliceous sand, with here and there an outcropping of tenacious clay. The banks are generally of a tough alluvial deposit, and, as usual with streams subject to floods, are slightly higher than the lands outside of them.

The course of the river, and of each of the many sloughs which drain into it, may be followed by the thick, luxuriant growth of swamp willows which lines their banks. On the higher ground cottonwoods flourish, and oaks are scattered at intervals over the entire district.

As may be readily understood, the high, steep bluffs on either side of the upper reaches of the river have offered great engineering obstacles to the diversion of water for the purposes of irrigation, and but one attempt to this end (which resulted in disastrous failure) has been made—that by the Upper San Joaquin River Canal Company.

The first feasible point along the river from which water may be easily taken for irrigation without the building of a long line of canal above the irrigable district is about 40 miles below Pollasky, where the Aliso Canal diverts water from the river. From this point down, on each side of the river, the high banks and the relatively low plain beyond make the construction of irrigating canals easy; and it is from this point on that we find in successful operation the systems of canals deriving their water from this river.

THE SOILS IN THE DRAINAGE AREA OF SAN JOAQUIN RIVER.

After the river leaves the mountains, as before described, the surface of the land is at first interspersed with outcroppings of primitive rock. The soil is thin and yields only scant pasturage and is nowhere much above hardpan or bed rock. An exception to the above condition is found in the bottom lands of the river from Pollasky downstream. These are composed of loose sand washings and river sediment, mixed with clay loam; are fertile, readily absorb water, and are easily irrigated.

As we proceed southward and westward along the river the rolling lands on either side are lean, compact, dry reddish clay and igneous mud deposits, with "hog wallow" formations prominently in evidence. The hardpan approaches close to the surface and is sometimes bare. The soil is so puddled by the clay ingredients that it is almost nonabsorbent of water; and irrigation, particularly by means of lateral absorption and subirrigation, is almost impossible. Some of these lands are summer fallowed, and thus are made to produce fair crops of cereals.

As we move farther in a southwesterly direction into the plain and irrigation sphere of Kings River we find the soil deep, absorbent of water, and remarkably well adapted to the best methods of using water and to the production of heavy crops.

This character of soil holds except within a strip a few miles in width south of the San Joaquin. On the north bank of that river the "hog wallows" and rolling lands run far down into the valley, and owing to their nonabsorbent character the country is difficult to irrigate, except in small areas here and there where alluvial deposits are found. This condition prevails until the middle plain is attained. There the high river banks and hills are left behind; the plain is only 40 or 50 feet above the river bed, and the soils on either side are looser, lighter, and better adapted to irrigation. On the south side they are deep, sandy, and nearly free from alkali. On the north side they are not as light, with the exception of the alluvial spots before mentioned. The surface is somewhat rolling, and often contains spots of alkaline soil. The depth to hardpan is not great, and altogether the soil is not as fertile nor as easily cultivated and irrigated as on the south side of the river in Kings River domain.

As we proceed toward the lower plain and the trough of the San Joaquin we encounter soils varied in constitution in different localities, often changing quickly within limited areas, being sometimes black adobe, then loose, sandy loam and river sediment, and again hard, alkali soil and compact hardened clay loam.

The lowest valley trough is subject to occasional overflow from the river, and in some parts to annual inundation.

Dr. E. W. Hilgard, professor of agriculture in the University of California, says of the soils of the San Joaquin Valley.[1]

> The higher plains have very uniformly, from Kern County to Stanislaus, a very sandy loam soil of great depth, and almost everywhere made of granite débris instead of quartz grains; hence, continually increasing their stores of mineral plant food by the weathering of the minerals present, a process which in so porous a material, subject, in its natural condition, to the free access of air during the greater part of the season, was evidently very rapid and as a consequence has developed unusually large amounts of the soluble products, which often appear in an inconvenient abundance in the guise of alkali. But little trouble arises from this cause in the high-lying sandy tracts, where irrigation or the natural rainfall carries the soluble salts annually into the country drainage. But in the low-lying and less pervious soils of swales and valley troughs, which are at the same time intrinsically the richest in available mineral plant food, the accumulation frequently causes considerable trouble and difficulty. There is on the whole, however, but little of the heavier class of adobe soils to be found in the San Joaquin Valley; what is currently so designated would in other regions sometimes be hardly classed as

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[1] California Station Rpt. 1888–89, pp. 115, 130.

a clay loam. The narrow belt of dark-colored clay, or adobe land, extends from the neighborhood of Merced City toward Stockton, where, northward of French Camp Slough and especially westward to the Coast Range, really heavy adobe, or prairie soils, prevail very largely. To the southward of the line of San Joaquin County adobe soils are found only in the river trough, and the soils of the west side are prevalently sandy all the way to the Tejon Mountains. * * *

The ancient deposits of the Kings River are represented by the "white ash" soils of the Central, Washington, and other colonies; while those of the San Joaquin side are reddish, sandy loams, contrasting pointedly with the "white ash" lands. This distinction is said to be maintained to a greater or less extent nearly to the trough or edge of the "tule" belt to the westward; while to the eastward of Fresno City both kinds of lands run out, as the foothills are approached, into a border belt of brownish clay loam (here also called adobe). * * *

The magnificent results of irrigation in the Fresno region, transforming what seemed an arid waste into a maze of orchards, vineyards, and fields, showing the most luxuriant growth of a great variety of products of the warm, temperate zone, can not readily be excelled as a cogent illustration of the benefits of irrigation in all its phases. Owing to the porous nature of most of its soils, and the fact that certain portions of the region are underlaid by more or less compact and impervious calcareous hardpan, it has also served conspicuously, in times past, to illustate the evils of overirrigation, resulting in the temporary "swamping" of lower lying lands and the development of alkali where it was never known before, and need not be hereafter under a rational system of drainage.

In the lower lands of the country to the northward, to the Fresno plateau, on the San Joaquin and Fresno rivers, as well as on Cottonwood Creek, we again find soils of a heavier grade, and with large supplies of mineral plant food.

RAINFALL.

Stated roughly and in round numbers, the annual precipitation of rain and snow on the high Sierras at the sources of San Joaquin River has a mean of 50 inches. In the lower mountains of its watershed the amount falls to 40 inches; on the foothills to 30; upon the higher plain to 20; and in the lowland trough of the river, at and near its great turn to the north, to 10 inches; from which locality it gradually increases in amount as we proceed down the valley to the mouth of the river.

FLOW OF THE RIVER.

The San Joaquin fluctuates widely in the course of the year, between a high or flood water level and a low or autumn flow. By gagings at Hamptonville (or Pollasky) and also at Herndon, the maximum flow of the river has been recorded as high as 59,800 cubic feet per second. The months of greatest flow are from January to July, inclusive. On the other hand, its minimum flow has fallen as low as 150 feet at Herndon. The months from August to October include the period of low water. In the winter and spring months the average discharge approximates to 5,000 to 6,000 cubic feet per second.

CLIMATE.

That part of the great interior valley drained by San Joaquin River contains 11,000 square miles. Its climate is quite different from that of the coast regions on the west, as well as from that of the high Sierras on the east. The annual rainfall is light, decreasing gradually from an average of about 12 inches in the lower valley near Stockton, to about 5 inches in the upper part near Bakersfield, approximately 225 miles distant.

Its atmosphere is very dry, particularly during the summer season; and consequently very conducive to the evaporation of water, both from the streams and the soil. The summer temperature is very high, but, owing to the dryness of the air, is not often oppressive or injurious to the health. In the winter season there is little or no destructive frost, and except in the mountainous districts, no large amount of ice or snow. The summer nights are usually clear, and owing to the uninterrupted radiation of heat and the descent of cold air from the Sierras, are cool and comfortable.

The prevailing winds in the valley are from the north, being in summer time the sea breezes of the coast that follow the river and lowland levels, and which come in a dried and tempered condition to the interior valley. In both summer and winter the valley is occasionally visited by "northers" or high north winds which blow with considerable velocity. Those of summer carry great volumes of desiccated air over the entire region, abstracting moisture from the soil and vegetation and evaporating immense quantities of water from canals and streams. The winter "northers" are usually cold, and frequently are dry, also.

The rain is usually brought by a warm southerly wind, and is seldom large in amount.

PRODUCTS.

Originally the great San Joaquin Valley was almost entirely cultivated for enormous crops of wheat, the farmers relying upon winter rains for the natural irrigation of the soil, or on summer fallowing to eke out the scanty rainfall. On the west side of the valley the precipitation is often deficient, no more than two or three crops of grain in five years being probable without artificial wetting of the soil.

As irrigation came to be practiced the waters of the San Joaquin and of the other rivers in the great valley were carried upon the fertile lands in the valley trough, and heavy and remunerative crops of raisin and wine grapes, orchard fruits, alfalfa, and the cereals were produced, as well as good pastures for immense herds of cattle; and it soon became evident that much of the valley land upon which irrigation water could easily and cheaply be introduced was too valuable for the production of ordinary and single crops of wheat or other grain. Consequently such areas were speedily converted into orchards and vineyards or into alfalfa fields from which three to five crops of the rich grass could be harvested each year.

IRRIGATED TRACTS IN THE VALLEY AND POSSIBLE EXTENSIONS.

The Aliso Canal, highest up on San Joaquin River on its right or easterly bank, and owned by Miller & Lux, a corporation, was constructed and is used for the purpose of irrigating wild grass lands in the river bottom of that locality. It improves the pasturage for herds of cattle belonging to the corporation and it irrigates an area of about 3,000 acres. Miller & Lux intend to further extend this irrigation.

Next below Aliso, on the same bank, is the Chowchilla Canal, belonging to the California Pastoral and Agricultural Company. It was constructed to irrigate the lands of the great Chowchilla Ranch, containing 107,000 acres. This ranch is mainly utilized for the pasturage of cattle and the raising of swine, but 3,300 acres of it are cultivated for alfalfa, 600 acres for barley, and 480 acres for grass. Much of the land in the Chowchilla Ranch is unfertile; nevertheless, with a large supply of water a greater area could be irrigated and improved. This supply, however, can hardly be obtained except by using a portion of the flood flow of the river, either by means of storage or irrigation in the high-water season. The benefit of irrigation in this region is shown by the well-known fact that irrigated lands are worth, on the average, at least twenty-five times the value of those in the same locality which remain unirrigated.

Some miles below the Chowchilla Canal, on the same bank and belonging to the same company, is the Blyth Canal, recently constructed for irrigating the wild grass lands on the Chowchilla Ranch. It is a short canal, 0.75 of a mile in length, and introduces water into the dry bed of the Fresno River, from which the water spreads out upon the adjacent plain and irrigates 9,000 acres of land. With a sufficient water supply this area could be largely extended or increased.

Still farther down on the right bank of the San Joaquin is the East Side Canal, sometimes called the Stevenson-Mitchell Canal, which irrigates 2,500 acres of land, distributed as to crops as follows: Alfalfa, 1,000 acres; barley, 300 acres; wheat, 100 acres; "hog corn," 100 acres; pastures and wild grasses, 1,000 acres. Much more land in the vicinity might be irrigated with a greater water supply; but no storage reservoirs are possible in this locality, and only by winter and spring flooding of the lands and storage of water could the irrigated areas be increased.

On the westerly or left bank of the San Joaquin we find, first, the James Canal, formerly known as the Enterprise Canal. It is owned by the James Canal Company, which possesses a large ranch of 65,000 acres, lying in the angle between San Joaquin River and Fresno Slough, and south and west of the latter. The company proposes to irrigate nearly the whole of this tract, either for pasture lands or for the production of alfalfa or cereals. Thus far, 42,650 acres have been irrigated from the canal; but at present its operation is enjoined by the superior court of Fresno County as the result of a suit brought against the company by Miller & Lux. The details of the litigation will be given hereafter.

Next on the river, below the James Canal, is the largest, most complex and extensive system taking water from the San Joaquin. It is known as the San Joaquin and Kings River Canal and Irrigation Company. Miller & Lux, a corporation, are the principal stockholders in this company. It owns the "Main" or "Old Canal," the China Slough, and Outside Canal, which form one line; the Parallel Canal and the Dos Palos Canal, with numerous branches. In addition to these, Miller & Lux own independently Poso Slough, Temple Slough, and Santa Rita Canal, which are used only to irrigate ranches belonging to that corporation. More than 100,000 acre of land have been, at one time or another, irrigated by this entire system, and in each year, on the average, about 50,000 acres are thus prepared for crops of alfalfa, cereals, or fruits. In addition to this must be mentioned the immense but indefinite areas of wild grass lands belonging to Miller & Lux, which are flooded by the high waters of the river taken in through Poso and Temple sloughs, and which furnish pasturage for cattle, bred and raised for the supply of the San Francisco market. With the present conditions of water supply it seems impracticable for this company and corporation to extend their irrigation systems very considerably, as they have no storage reservoirs, but rely upon the flow of San Joaquin River for the required amount of water. The length of their supply canals already reaches 87 miles, and these have branches amounting in all to over 200 miles in length. With an increased supply of water from storage this side of the valley, the west side plain, for a much greater distance down toward the mouth of the river, might be successfully and profitably irrigated, and, in fact, the area of land under the ditches and the crops produced could undoubtedly be multiplied several times.

The irrigation possibilities of the river, so far as the ordinary flow is concerned, seem to have been fully exploited, and further extension of irrigated area will depend entirely upon the storage of storm and flood waters.

Irrigation along San Joaquin River is practiced both for the wetting of barley and alfalfa tracts, where the soil is too alkaline for the production of other crops, and for the cultivation of various cereals, grapes, and orchard fruits where the absence of alkali permits. It is also used to improve the pasturage on the wild grass lands in the river bottom.

This list includes all the irrigation systems taking water from San Joaquin River and the lands irrigable therefrom; but, as Fresno River and Chowchilla Creek are natural tributaries of the San Joaquin and are in close proximity to it, I shall include in this report descriptions of these streams and of the lands which may be irrigated from them.

FRESNO RIVER.

This river has a drainage area of 272 square miles. Its sources are in the lower mountains and foothills on the east side of the San Joaquin Valley; consequently it is fed principally by the rains which fall upon these elevated lands, and derives comparatively little of its water from melted snow; therefore, it is a torrential stream, subject to great and sudden floods, and afterwards usually quickly subsides into ordinary flow, or even a dry state. The months in which the greatest flow occurs are December to June, inclusive. During the remainder of the year its bed is nearly or quite dry.

Records available show a monthly mean flow sometimes as great as 1,632 cubic feet per second; but the general average is much lower than that, running from 200 to 500 cubic feet per second during the wet months.

The waters of this river, carried in the Madera Canal and Irrigation Company's ditches, are used first to irrigate alfalfa on from 100 to 300 acres of land on the Adobe Ranch, 10 miles above the town of Madera. This area could be increased, probably, to 1,000 acres, by a sufficient water supply. The main field of distribution from the canal is upon what was formerly known as the Howard & Wilson Colony lands, about a mile below or southwesterly from the town of Madera. About 40,000 acres of irrigable land lie under the ditches of this company, of which one-half have been irrigated at different times. The maximum area irrigated in any one year has been 14,000 acres. During last year—1899-1900—the company watered 7,100 acres. As the water supply for this canal is limited, the irrigated area depends largely upon the amount of the rainfall and the resulting quantity of water flowing in the river. With ample storage capacity, the entire 40,000 acres of land might easily be irrigated, and to great advantage. In fact, there is a very large area of land lying beyond this colony, to the south and west, which might easily be brought under the ditches, if water were available. This company is already preparing to improve its canal system and to greatly increase its storage power. The particular crops produced in 1899-1900 were: Wheat, 300 acres; barley, 600 acres; grass and alfalfa, 3,000 acres; vineyards, 2,000 acres; orchard trees, 1,000 acres; Egyptian corn, 200 acres.

CHOWCHILLA CREEK.

Chowchilla Creek is similar in origin and characteristics to Fresno River, already described. It has a drainage area of 268 square miles, and, like the Fresno, is subject to sudden freshets in the rainy season. Records have given it a mean monthly flow as high as 1,608 cubic feet per second, but its average during the months from December to July, inclusive, is far below that amount, being approximately 150 cubic feet per second. The months from February to June, inclusive, furnish the greatest flow, averaging 333 cubic feet per second; but the months from July to October, inclusive, ordinarily afford little or no water.

The only irrigation systems on Chowchilla Creek are those of the Sierra Vista Vineyard Company and the Bliss ditches. By means of dams across the bed of the creek they utilize the flow of the stream to irrigate some 6,000 or 8,000 acres of land lying on either side of the stream, upon which vineyards, fruit trees, alfalfa, and pasture lands are cultivated or improved. The area irrigated in any one year is largely dependent upon the rainfall and the resulting water supply in the creek. The irrigated area might be largely increased by multiplying the number of dams and thus establishing a series of impounding reservoirs in the bed of the stream. As it is, during freshets, much water must be turned aside into the beds of Berenda and Ash sloughs in order to avoid the destruction of the dams. Such new impounding dams should have stability sufficient to resist destruction by sudden floods and freshets. There are, also, one or two excellent reservoir sites in the mountains above Buchanan, where large quantities of water might be stored.

The valley lands adjacent to the San Joaquin and its branches, now being irrigated by existing canals, approximate 120,000 acres in cereals, fruits, and alfalfa, and the area of wild grass lands which are overflowed by the flood waters of the river is fully double this amount.

ESTIMATE OF TOTAL AREA OF LAND WHICH MIGHT BE IRRIGATED FROM SAN JOAQUIN AND FRESNO RIVERS AND CHOWCHILLA CREEK.

In making this estimate I proceed on the assumption that the duty of water in this region, the valley trough, is approximately 160 acres per cubic foot per second. I assume this duty because no positive and definite information has been available as to the exact duty of water on the different irrigated areas investigated by me, but the general consensus of opinion among canal owners, ranch owners, and canal superintendents is that the above is a fair approximate average of the duty of water.

I find from Hall's tables of flow of water in San Joaquin River, established by gagings from 1878 to 1884, inclusive, that the average number of cubic feet per second for the period from November to January, inclusive, is 750, which, upon the assumption that a cubic foot per second will irrigate 160 acres of land, would, during this period, properly irrigate 120,000 acres of land if all the water flowing were available for irrigation. In the same way the average flow for the period from February to April, inclusive, being 2,462 cubic feet per second, would serve 393,920 acres; in the period from May to June, inclusive, the mean of about 7,458 cubic feet per second would irrigate 1,193,280 acres, and during August to October, inclusive, the 808 cubic feet per second, average mean flow, would irrigate 129,280 acres of land.

Under the supposition that this water could be stored and dealt out throughout the year as might be necessary, it would furnish 3,074 cubic feet per second, and would, according to my assumption, irrigate fully 490,000 acres, instead of 120,000 (omitting the wild grass lands, indefinite in extent) which are irrigated at the present time. In other words, more than four times the present irrigated area might be brought into the watered region with a corresponding increase in values and productiveness.

As the flow here given is only the average during six years, and is greatly in excess in some months and deficient in others, the necessity for ample storage is apparent.

The gagings of Fresno River for the same years show that in the period from November to January, inclusive, the average flow is 66 cubic feet per second, which, with a duty of 160 acres per cubic foot per second, would serve during this period 10,560 acres. In the interval from February to April, inclusive, the average flow is 482 cubic feet per second, which, on the same basis, would serve 77,120 acres. From May to June, inclusive, 127 cubic feet per second, the average flow, supposing all the water to be available, would provide for 20,320 acres. In the period from August to October, inclusive, the flow is given as 3 cubic feet per second, which would irrigate only 480 acres. In the same way, as before explained, if the entire flow of the river, which averages 160 cubic feet per second throughout the year, could be stored and dealt out as required it would provide for 25,600 acres, instead of the average of 10,000 acres, or an area over two and one-half times as great as is at present irrigated. As in the case of the San Joaquin, the necessity for ample storage is apparent. The irrigated region might well be extended in a direction southerly and westerly from the town of Madera.

The records of the flow of Chowchilla Creek during the years 1878 to 1884 give for the period from November to January, inclusive, a mean discharge of 44 cubic feet per second, which, on our assumption, should provide for 7,040 acres during that period. From February to April, inclusive, 456 cubic feet per second is the mean flow, which should provide for 72,960 acres. From May to June, inclusive, the mean flow of 118 cubic feet per second should provide for 18,880 acres, and from August to October, inclusive, 2 cubic feet per second would provide for only 320 acres. By storing and regulating the supply as before described, about 24,640 acres might be irrigated throughout the year instead of 5,000 or 6,000 acres during a few months of each year, as now.

At present much of the freshet water of the Chowchilla is lost to irrigation by being turned aside into Ash and Berenda and other sloughs in order to prevent the destruction of the dams yet remaining intact. The advantages of storage and continuous supply in these cases seem very evident, and as the soil and topography of these localities are peculiarly suited to irrigation the irrigable area might be largely increased, probably by 15,000 acres.

Under the assumption which I have made, it is possible to increase, through storage of flood waters, the irrigable lands on the streams mentioned, as follows:

Possible extension of irrigated area under San Joaquin and Fresno rivers and Chowchilla Creek.

Stream.	Present area.	Possible area.
	Acres.	*Acres.*
San Joaquin River	120,000	490,000
Fresno River	10,000	25,600
Chowchilla Creek	6,000	24,640
Total	136,000	540,240

Of course, in this computation we have taken no account of the loss of water from percolation into the soil, or by evaporation in storage reservoirs; but this would be relatively small in amount.

APPROPRIATION AND DISTRIBUTION OF WATER.

The right to the use of water from streams in California may inhere in the riparian proprietor or may be acquired by complying with the statutes of the State for the appropriation of water. Rights to water acquired under the civil, Spanish, or Mexican laws before California came under the control of the United States are guaranteed and protected to the fullest extent. Appropriations of water must be for a beneficial purpose.

The method of appropriating water as described in the statutes is as follows:

> SEC. 1415. A person desiring to appropriate water must post a notice, in writing, in a conspicuous place at the point of intended diversion, stating therein:
>
> (1) That he claims the water there flowing to the extent of (giving the number) inches measured under a 4-inch pressure.
>
> (2) The purpose for which he claims it, and the place of intended use.
>
> (3) The means by which he intends to divert it, and the size of the flume, ditch, pipe, or aqueduct in which he intends to divert it.
>
> A copy of the notice must, within ten days after it is posted, be recorded in the office of the recorder of the county in which it is posted.

In order to determine the amount of water "filed on" and appropriated from San Joaquin River, Fresno River, and Chowchilla Creek, respectively, I studied the records of water claims filed in the offices of the county recorders of Fresno, Madera, and Merced counties, first having ascertained that those were the only counties in which water for irrigation was claimed by appropriators from these streams; and also made diligent inquiry among irrigators and old residents interested and well informed as to irrigation matters. I found filings on water made as far back as 1857. These very early claims were usually for water to be used in mining and milling ores, and were made at points in the mountainous regions around the sources of the San Joaquin. These early records were often very indefinite both as to the location of claims and the amount of water appropriated; but probably in the ordinary case the water claimed was, after use, turned back into the stream. It would have been practically impossible, however, at a later date for another person to decide upon either the validity of the claim or the locality in which it was made, owing to the looseness of the description.

In endeavoring to determine the amount of water appropriated on each of the streams under consideration, seven large volumes of water claims and one volume of the records of the board of supervisors of Fresno County had to be carefully gone over and, as far as possible, the streams, branches, tributaries, and claims identified. In many cases forks, branches, and small tributaries were mentioned and water claimed therefrom by persons whose names were unknown not only to the county recorder and his deputies but to the county surveyor and his predecessors in office and even to the "oldest inhabitant" of the region supposed to be the locality specified. Again, in the wording of the claim no statement would be found as to whether the stream on which water was claimed was a tributary of the San Joaquin or of some other river, and since the filing of the claim the name of the stream might have been changed once, if not oftener. The miners and irrigators in the early days gave fanciful and arbitrary names to streams, gulches, and valleys, which later were changed and in time forgotten.

Another confusing feature was the fact that a great number of streams bore the same name, as, for instance, a great favorite, Whisky Creek, and also Jackass Creek, Bear Creek, Mill Creek, etc. Some of the streams bearing these names were tributaries of the San Joaquin and others of Kings River. It was necessary to look up on the map the section, township, and range in which the claim was located in order to decide whether the stream named was a tributary of the San Joaquin or of some other river. When, as was often the case, no section, township, or range was mentioned, it was practically impossible to locate the claim unless some natural object—such as a ranch, bridge, or abandoned mine—was mentioned which happened to be known by some person questioned by us. There were also numbers of claims on streams which had at one time or another been tributaries of the San Joaquin, but had since been diverted or had sunk into the sands to disappear before reaching the main stream. It was necessary to look up these streams and ascertain by inquiry whether any of their water, in times of flood, still reached the San Joaquin.

Many tributaries of this river on which claims were located did not appear at all on maps of the county, and could be "run down" only by close inquiry among miners, mountaineers, sheep men, and State forest or fish commissioners who were familiar with the ground. Some claims on Minaret Creek had eluded our closest scrutiny, and we had about decided to pass them as not belonging to the San Joaquin when fortunately we met a fish commissioner who knew the locality and was able to inform us that the creek in question was quite a bold stream and an undoubted tributary.

The ignorance of standards of measurement of flowing water, even in cases of corporations appropriating large amounts, was very evident and often disagreeably prominent. Square inches and square feet of water were often claimed, as well as "cubic inches" and "cubic feet" under a 4-inch pressure; and the powers of translation of the writer in endeavoring to interpret the real meaning of the appropriator were often severely taxed. Again, claims to immense quantities of water, ridiculously disproportionate to the means stated for diverting them, were a common feature; and claims to "all the waters in the river" or to millions of miner's inches were frequently encountered in the search of the records.

It was found to be practically impossible, except in the cases of the few existing canals, to ascertain if the water claimed had ever been used. The writer can conceive of no more difficult task for the searcher of records than to trace and pass upon the validity of almost any of the older water claims filed in these counties during the last thirty years, naturally the result of the careless and indefinite statute prescribing the form and method of appropriation.

In order to more clearly show the looseness and indefiniteness in claiming water, I give herewith some extracts from the records in each of the three counties.

The following notice is an example of indefiniteness both as to quantity of water claimed and of the locality in which it is to be taken. It will be seen also that no mention is made of the point where the water is to be used:

Mill Creek, a tributary of the North Fork of the San Joaquin. Dated June 20, 1878.

I hereby give notice that I claim 2 feet of the waters of Mill Creek, same to be measured under 4-inch pressure. Said water to be used for irrigation purposes. Said water to be diverted by means of a ditch, to be taken out of said Mill Creek at a point about 10 yards above where the train from Ridenhars to Hurses crosses Mill Creek.

Another of these earlier claims is as follows:

North Fork of the San Joaquin. Dated the 8th day of October, 1877.

Know all men whom it may concern that I, ——— ———, of the above-named State and county, have this 8th day of October, 1877, appropriated and claimed all the water for 1 mile below John Hern's mill, or to the extent of 5,000 cubic inches, measured under a 4-inch pressure, flowing into the North Fork of the San Joaquin River in Crane Valley, in said State and county, to be used as stock water and for agricultural purposes, to remain in its natural channel, along with the privilege of diverting 1,000 cubic inches, measured under a 4-inch pressure, from said North Fork, at any point most convenient, within any point from one-fourth to 1 mile below John Hern's mill, in said State and county and valley, to be conducted from said channel by ditch and flume of 3 feet wide and 2 feet deep.

Recorded 18th of October, 1877, in Book A of Water Rights Records of Fresno County, Cal., page 121.

Fine Gold Gulch, a tributary of the San Joaquin. Dated 27th day of April, 1878.

Notice is hereby given that we claim the waters of this stream and all its tributaries from this point up, to the amount of 5,000 cubic inches of water, measured under a 4-inch pressure, for mining purposes. The original of this notice is posted on a white-oak tree on the south bank of the north fork of the stream of water known as Fine Gold (Gulch ?), about 3 miles northerly from the residence of J. B., in Fresno County, Cal., and is located this 27th day of April, A. D. 1878.

If all the tributaries of this stream are definitely known in position on the map and in the country, and we know exactly what appropriators mean by "cubic inches of water, measured under a 4-inch pressure;" and if there are no other white-oak trees in that vicinity; or if the white-oak tree has not been cut down, blown down by the wind, or struck by lightning; and if "3 miles northerly from the residence of J. B." means exactly 3 miles in exactly a north direction; and if J. B. has not moved away so long ago that he is forgotten, then we may regard this location as a very exact and definite one. But otherwise it would probably be very difficult to determine the point where this appropriation was made, with a view of ascertaining whether the water claimed was actually used. And if we could not interview the three appropriators, we might still be left in doubt as to the amount of water claimed.

South branch of Kaiser Creek. Dated March 29, 1881.

Notice of location: Notice is hereby given that we, the undersigned persons, claim 400 inches of the water of this creek, where this notice is posted, this creek being one of the south branches of the Kaiser Creek. The water is to be taken out where this notice is posted and conveyed in a flume and ditch to the side of the ridge next to Kaiser Creek, and used in hydraulic and "min." purposes, and returned to its original channel about 2 miles below.

Dated at Kaiser Creek, Fresno County, Cal., March 29, 1881.

V. B. C. claims "The water of the San Joaquin River * * * to the extent of 51,840 cubic inches, under a 4-inch pressure."

San Joaquin River. Dated October 20, 1887.

Notice.—Notice is hereby given that we claim the waters of the San Joaquin River to the extent of a flow of 3,456,000 cubic inches under a pressure of 4 inches; that we intend to use said water for irrigation, navigation, domestic, and manufacturing purposes; that we intend to use said water on the east of the San Joaquin River and on the west of the foothills of the Sierra Nevada Mountains, and in the counties of Fresno, Merced, and Stanislaus; that the course of the canal will be easterly and northerly; that we intend to construct a canal of sufficient size and capacity, to be not less than 60 feet wide on the bottom, nor less than 75 feet wide on the top, and to be 7 feet deep, reckoning from the grade to the top of the embankment. (The point of diversion of said water is on the right or east bank of the San Joaquin River, at or near the end of a large slough, at or near where this notice is posted.)

Fresno County, October 29, 1887.

Recorded November 4, 1887, in Book B of Water Rights Records of Fresno County, Cal., pages 50–51.

A. B. and J. B. claimed "500 inches, miner's measurement, under a 4-inch pressure, or all of the waters of this Willow or North Fork Creek. * * * The point at which we take the waters of said stream for the purposes aforesaid is about 20 feet in a southeasterly direction from a certain yellow-pine tree marked B. D., on the west bank of said stream, and on which this notice is posted, and about 14 feet in an easterly direction from a certain white live-oak tree, also marked B. D., on the west bank of said stream." * * * It is hoped that these trees are not situated in the forest, and that they still remain standing, although probably the "B. D.'s" are now illegible.

Fifteen miners claim 250 feet of the water under a 4-inch pressure from the south branch of the South Fork of the San Joaquin. Probably they knew what they meant by 250 feet of water under a 4-inch pressure. But it is very doubtful if H. N. B. did know exactly what he meant by claiming "4 square feet of the water of Whisky Creek, measured under a 4-inch pressure."

On the Chowchilla Creek, 4,000 and 20,000 cubic inches, measured under a 4-inch pressure, are claimed.

The K. C. A., and J. P. and W. M. propose to take out 5,000 miner's inches, under a 4-inch pressure, from the San Joaquin River, or 100 feet of water; but to make sure that they can transport this quantity, they propose to make a canal 150 feet wide and 6 feet deep, which, even with a velocity of 1 foot a second, would transport 900 cubic feet of water per second—a large river in itself.

M. J. B. and R. B. propose to take 5,000 miner's inches of water from the San Joaquin River and transport it in a ditch 2 feet on the bottom, 4 feet on top, and 3 deep, with a grade of 16 feet to the mile. As the area of cross section of the ditch through which this 100 cubic feet of water per second must pass is only 9 square feet, the water must have a velocity of more than 11 feet a second, and therefore M. J. B. and R. B. should carefully line their ditch with cast iron, in order that it may not be washed away at the first rush.

These notices, taken at random from nearly 400 on record, illustrate the discrepancies which arise in the practice of hydraulics, as well as the uncertainties of appropriations under the existing prescriptions in the statutes.

SUMMARY.

The number of claims of water from the San Joaquin and its branches is 316, not including those from Fresno River and Chowchilla Creek.

"All water flowing in the San Joaquin River" is claimed in so many words by different persons six times, in addition to a total of 461,794 cubic feet, omitting all reappropriations. "All the flow" in many of the branches and forks of the San Joaquin was claimed over and over again; as, for example, Big Sandy, Whisky Creek, and Stevenson Creek.

The greatest flood flow, for even a short time, of the San Joaquin River, according to gagings during eight and one-half years by William Hammond Hall and J. B. Lippincott, is 59,800 cubic feet per second, and therefore the claims of water above given are nearly eight times the greatest flood flow of the river during this eight and one-half years specified, and are 172 times the average flow per second, 2,680 cubic feet, during the period mentioned. Of course, we must add to this total the sixfold claim of "all water of the river." As the water of the San Joaquin is not in the condition of an elastic vapor, one experiences great difficulty in understanding how all these claims could be satisfied.

On Fresno River and its tributaries 50 claims of water have been made. Besides 670,799 miner's inches, or 13,416 cubic feet per second, filed on, "all the water of Fresno River" was in addition claimed once. In five instances the quantity was not mentioned, and might have been anything from 1 miner's inch to the entire stream; and in another instance "enough water" was claimed, and only specified by the dimensions of the flume, namely, a flume 30 feet wide, 4 feet deep, and having a fall of 5 feet per mile, evidently carrying a generous quantity of water, which would have left comparatively little to other appropriators, even in flood season.

The waters of Coarse Gold Gulch, one of the tributaries of the Fresno River, were separately claimed three times over, in addition to 2,500 miner's inches, or 50 cubic feet per second. This being a small stream, dry at certain seasons of the year, the writer believes that some of the claimants must occasionally be disappointed.

Hall's record for the greatest mean rate of monthly discharge of Fresno River, during six years' observation, gives 1,632 cubic feet per second, and therefore the quantity of water claimed, in addition to "all the water of the river," is eight times this greatest mean flow per second, and is eighty times its mean yearly discharge, 160 cubic feet per second.

For the waters of Chowchilla Creek 14 claims have been made, aggregating 31,008 cubic feet per second, plus two claims for quantities not given. The gagings of Chowchilla by William Hammond Hall during the six consecutive years before specified gave the greatest flood water of this stream during that period as 10,770 cubic feet per second. Therefore, on this stream three times the amount of its greatest recorded flood flow per second has been claimed, or 204 times the annual uniform flow of the creek, which was 152 cubic feet per second.

Of the total number of claims to water from the San Joaquin and its branches, omitting those from Fresno River and Chowchilla Creek, at least 115 of the total number (316) are so indefinitely described as to the point of appropriation or diversion that it would be exceedingly difficult, if not impossible, to determine that point. None refer to section, township, or range of the Government survey, and we find them usually oriented by means of natural objects, as trees, bowlders, ranch houses, etc., which may have disappeared, been destroyed, or have changed owners.

Of the total number of claims to water from Fresno River and its branches, namely, 50, 21 are indefinite, as before described in the case of San Joaquin River, and for similar reasons.

Of the 15 claims to water from Chowcnilla Creek, 3 are very defective, 2 being practically unrecognizable as to locality.

Besides those just mentioned, there were locations on 11 streams or lakes which I found impossible to identify. The claims amounted to 152,750 miner's inches, besides two quantities not given, and one claim to "all the water of Kelloggs Creek." After diligent and long-continued search in every quarter holding out any promise of information—and how careful that search was has already been indicated in describing our methods—the identification of these claims and streams was of necessity abandoned.

All the canal and irrigation companies taking water from San Joaquin River, Fresno River, or Chowchilla Creek, with probably the exception of the San Joaquin and Kings River Canal and Irrigation Company, claim vested riparian rights. Also, numerous individuals, riparian to one or more of these streams, make similar claims. None of these, so far as the writer could ascertain, has been adjudicated; and in consequence it is practically impossible to state their exact amount.

The following table sums up the claims on San Joaquin River and its tributaries so far as they are for definite amounts:

Definite claims to water from San Joaquin River and tributaries.

Name of stream.	Number of claims.	Amount claimed.
		Inches.
Main San Joaquin River	70	28,244,420
North Fork	67	4,432,706
Little North Fork	6	41,000
First North Fork	4	18,000
South Fork	4	13,932
Chowchilla Creek	12	2,550,400
Chiquita River	12	83,700
Fine Gold Gulch	12	38,800
Fresno Slough	1	3,550
Whisky Creek	20	10,900
Sand Creek (probably more than one)	9	15,000
Big Creek	9	252,775
Segiuna Creek	2	360
Kaiser Creek	16	17,700
Little Dry Creek	1	1,500
Stevenson Creek	7	159,440
Pitman Creek	3	12,500
Winchell Gulch	1	1,000
Kinsman Creek	1	12
Minaret Creek	3	3,300
Slick Rock Creek	1	500
Deer Creek	1	1,000
Ross Creek	1	1,000
Mill Creek	1	4,000
First Clipper Mill Creek	2	6,500
Second Clipper Mill Creek	1	5,000
Kings Creek	1	1,000
Jackass Creek	1	100
Bear Creek	1	800
North Branch Creek	1	300
Rock Creek	1	400
Quaking Aspen Creek	1	200
Sockanew Creek	1	100
Fresno River and tributaries	41	649,376
Total	315	36,571,471

NOTE.—It was found impossible to make exact groupings of streams, but those given are approximately correct.

EVOLUTION OF WATER LAWS IN CALIFORNIA.

As stated before, the history of irrigation in California began, from a legal standpoint, with the coming of the gold seekers in 1848. Previous to that time the mission fathers had cultivated their vineyards and orchards, using aqueducts and small systems of artificial irrigation modeled on the method of Mexico and Spain; but very little water had actually been used and no occasion for dispute or necessity for local laws had arisen.

But with the coming of the miners and the location of their mining claims water for their working became an imperative necessity, and often the water acquired had to be conveyed by means of ditches and flumes. The necessity for laws to regulate these appropriations of water was evident. Each locality adopted its own simple rules, based on common sense and justice, and, as before stated, those of the different mining districts, however widely separated, were practically identical. The lands being a part of the public domain of the United States, the first appropriator was held to have, within certain well-defined limits, a better right than others to the claim he had taken up, and this rule was also applied to the water necessary to the working of the claim. The first appropriator of water to be conveyed to a locality for mining or other beneficial purposes was recognized as having, to the extent of actual use, the better right. The doctrine of the common law respecting the rights of riparian owners was not considered applicable, or, at most, only in a very slight degree, to the conditions of miners.

In 1851 the State legislature of California enacted a law sanctioning the "mining customs" when not in conflict with the constitution and laws of the State. This enactment was based upon a new principle governing the rights to water in the United States, the principle of priority of appropriation or of the first appropriator being first in right.

But in 1850 the legislature had adopted the common law of England when not in conflict with the Constitution of the United States or the constitution of California. Thus there were established in the State two distinct systems or rules of law governing the use of water, one having its foundation in the equal right of all riparian owners to the flow of the stream, without material diminution in quantity or alteration in quality, regardless of any priority, and the other having for its basis the law of priority of appropriation and use, without any ownership of the soil being necessary, and without any obligation on the part of the owners to turn the water thus diverted back into the natural course of the stream.

The law of riparian rights, brought over from England, a nonirrigating country, and embodied in our common law, has been greatly modified in its application. The right of the riparian owner to have the waters of the stream flow past his lands "unpolluted and undiminished in volume" has been encroached upon by the necessity of other riparian owners to use water for irrigation; and the question, Shall irrigation be considered an artificial or a natural use of water? has been answered by the courts. The courts hold that the circumstances of the case should decide the question. In a country where irrigation is a necessity, as in California, irrigation is a natural and reasonable use of water; and riparian owners are entitled to use the waters flowing past their lands for that purpose within reasonable limits. Rights acquired under the civil, Spanish, and Mexican laws before California was transferred to the United States were also by treaty and statute fully protected.

STATUTORY LAWS RELATING TO WATER RIGHTS.

On the 1st of January, 1873, the civil code of California went into effect. Among its provisions are the following for the acquisition of water rights:

> SEC. 1410. The right to the use of running water flowing in a river or stream or down a canyon or ravine may be acquired by appropriation.
>
> SEC. 1411. The appropriation must be for some useful or beneficial purpose, and when the appropriator or his successor in interest ceases to use it for such a purpose the right ceases.
>
> * * * * * * *
>
> SEC. 1414. As between appropriators the one first in time is the first in right.
>
> SEC. 1415. A person desiring to appropriate water must post a notice in writing in a conspicuous place at the point of intended diversion, stating therein:
>
> (1) That he claims the water there flowing to the extent of (giving the number) inches, measured under a four-inch pressure.
>
> (2) The purpose for which he claims it. and the place of intended use.
>
> (3) The means by which he intends to divert it, and the size of the flume, ditch, pipe, or aqueduct in which he intends to divert it.
>
> A copy of the notice must, within ten days after it is posted, be recorded in the office of the recorder of the county in which it is posted.

It will be observed that the particular form of notice is not prescribed. The courts have decided that the notice need merely be sufficient to give any intelligent man proper warning, and its language must be liberally construed.

Due diligence in diverting the water and completing the works after the posting of the notice is required by law, and neglect to comply with this regulation brings forfeiture as against a subsequent claimant who has complied with the law.

RIGHTS OF RIPARIAN PROPRIETORS.

In the civil code it was provided, by section 1422, that "The rights of riparian proprietors are not affected by the provisions of this title." This section was repealed by the legislature in 1887, with a proviso. Sections 1 and 2 of the repealing act read, in part, as follows:

> SEC. 1. Section 1422 (describing) is hereby repealed; provided that the repeal of this section shall not in any way interfere with any rights already vested.
>
> SEC. 2. This act shall take effect from and after its passage.

Although this repealing statute seemed to be, at the time of its passage, positive and definite in its intention to absolutely abolish the riparian law, yet it has been held by the courts to in no wise affect the riparian rights of private lands, and to apply only to the public lands and their waters belonging to the United States.

With the exception of the act repealing the law of riparian rights, the statutory enactments previously given simply embody the principles and practice in the matter of water rights previously recognized in the State.

THE WRIGHT DISTRICT LAW.

In 1887 the now famous "Wright law," so called, was enacted. It was entitled "An act to provide for the organization and government of irrigation districts and to provide for the acquisition of water and other property, and for the distribution of water thereby for irrigation purposes."

Its passage grew out of a desire to end the interminable litigation arising between the appropriators of water for beneficial purposes, on the one hand, and the riparian owners, holding rights acquired before the repeal of the riparian law, as before explained, on the other. This litigation had threatened the life of irrigation in California, and it was generally felt that a decisive step must be taken in the right direction.

This law provides for and authorizes the formation of public corporations called "irrigation districts."

Section 1 provides that 50, or a majority of the holders of title to lands susceptible of irrigation from a common source and by the same system of works, may organize an irrigation district under the provisions of this act.

Section 2 provides the manner in which the district shall be organized, namely, by petition to the board of supervisors and the filing of a sufficient bond in double the amount of the probable cost of organizing the district. The board of supervisors may exclude from the proposed district any lands which will not be benefited by its formation. The matter shall then be voted on by the people at an election held for that purpose and conducted as nearly as practicable in accordance with the general laws of the State. A two-thirds vote in favor of the formation of the district is necessary to authorize it.

Sections 3 to 11, inclusive, relate to the election of officers and their duties.

Section 12 confers authority upon the board of directors of the district to acquire—

> by purchase or condemnation, or other legal means, all rights and water rights and other property necessary. * * * In case of purchase, the bonds of the district hereinafter provided for may be used at their par value in payment, and in case of condemnation the board shall proceed in the name of the district according to the laws of the State provided in such cases. The use of water required in any irrigation district, together with the right of way for canals and ditches, sites for reservoirs, and all other property is hereby declared to be a public use.

Section 13 provides that the legal title to all property acquired under this act shall immediately vest in such irrigation district, and shall be held by such district in trust.

Section 15 provides for the issuance of bonds to raise money for construction, provides for special elections on the question, for the method of payment of the bonds, and for special assessments when the sale of the bonds fails to furnish sufficient money to complete the work.

Section 17 provides that the bonds and their interest shall be paid by means of an annual assessment upon the real property of the district, such assessment to be a preferred lien.

Section 34 provides for the payment and redemption of the bonds.

Sections 35 and 36 provide for bids for the construction of the irrigation works and for the payment of said work.

Section 43 provides for the apportionment of water pro rata in case of deficiency.

Section 45 specially provides that the navigation shall not be impaired by the operation of this act, nor shall any vested rights already existing in water used for mining purposes be disturbed.

Section 46 provides that none of the provisions of this act shall repeal or in any wise modify the provisions of any other act relating to the subject of irrigation or water commissioners; nor shall any private property be taken or injured without compensation.

A number of supplementary acts have been passed since the enactment of the law, modifying or strengthening certain portions of the act.

This law has been repeatedly attacked in the courts of the State, and at every assailable point, but has, without exception, been held to be constitutional by the supreme court of the State. It has also been carried into the United States courts, and although declared unconstitutional in a decision by United States Circuit Judge E. M. Ross, was subsequently upheld by the Supreme Court of the United States on the points involved.

A large number of irrigation districts have been organized in the State, and many of them, particularly in southern California and in Kern and Tulare counties, have been successful; but others have been at least financial failures. It would seem to the writer that the lack of success in these instances was not due to defects in the law, nor to the difficult engineering problems involved, but to bad financial and executive management. In some instances where districts have been organized and bonds issued, interest is long overdue and irrigation works have not been as yet constructed, or at least completed. The farmers in the district are assessed when no benefits are immediately derived. Default in payment of interest and expenses has resulted, and the financial state of the irrigation districts is in a chaotic condition. Such outcome, as the writer believes, is much to be regretted, as, with skillful management, under naturally favorable circumstances, the irrigation-district system ought always to be successful. It involves the idea of local self-government, control, and taxation, and disposition of the taxes received, and, further, retains for the use and benefit of the farmers in the immediate locality the waters which otherwise might be diverted to remote districts.

LITIGATION OVER WATER RIGHTS ON SAN JOAQUIN AND FRESNO RIVERS AND CHOWCHILLA CREEK.

IN THE SUPERIOR COURT OF FRESNO COUNTY.

As compared with other rivers in the State, there has been very little litigation growing out of disputes over water rights in these rivers; and the cases that have occurred are scattered over a number of years. In many of the cases the disputes arose over a construction of the rights of riparian owners, as opposed to those of appropriators. No adjudication of the water rights of any of the canal or irrigation companies taking water from any one of these streams has been had.

The first case of any interest is that of Wm. Howard et al. *v.* John G. Stitt, No. 522, Fresno County. The complaint recites that Fresno River flows over and through a certain section, township, and range; and that for many years previously the grantor of plaintiffs appropriated for irrigation purposes the waters of said river to the amount of 17,800 inches, and that said water has since been used to irrigate the lands of plaintiffs and others. This claim is based on prior appropriation, and also on riparian rights. The specific complaint against defendant is that he is building a canal to take water from the river above the point of diversion of plaintiffs, and will thereby reduce or entirely cut off their supply, and an injunction is prayed for. Although this action was begun some seventeen years ago, subsequent proceedings have not been taken, and the action still remains in the lower court.

In 1889 an action was brought to establish the validity of the organization of the Madera irrigation district and of its bonds. The right to appropriate water from the river is not questioned—only the legality of the district organization. The principal opponents of the district were riparian owners, such as Miller & Lux, George D. Bliss, the California Pastoral and Agricultural Company, the Sierra Vista Vineyard Company, and others. The action was decided by the local court in favor of the district. An appeal was taken to the supreme court of the State. The district, however, while the matter was pending in the supreme court, confessed error, and the order of the trial court was thereupon reversed.

The case of Chapin *v.* Albert Brown et al., No. 4272, brings in the matter of conflict between riparian rights and rights by appropriation. Plaintiff averred that Whisky Creek flowed over and through his lands, and that he used the waters of said creek for irrigation and domestic purposes. This complaint clearly set up riparian rights. The plaintiff complained that defendants intended to divert the waters of said creek by means of a dam to be built above plaintiff's land, by reason of which plaintiff's water would be cut off or reduced greatly in amount, and he prayed for an injunction. Defendants answered that they also owned certain lands bordering on said stream, and moreover, that they had appropriated certain waters of said creek pursuant to law, and had prosecuted diligently the construction of irrigation works, thus making their claim both on riparian rights and appropriation and use. In this case the law of riparian rights was upheld by the trial court. The defendants having been unable to show that the water they proposed to divert was to be used on riparian lands, judgment was entered in favor of the plaintiff. An appeal was taken to the supreme court, which reversed the judgment and remanded the cause for a new trial. The remittitur was filed in 1894. No further action has been taken since then. This case is a good illustration of the conflict arising between existing riparian rights and rights by appropriation and use.

The case of Jesse B. Ross *v.* James Lawson (No. 4821), brought in 1894, involved the question of priority of right by appropriation. Plaintiff claimed all the waters of Sockanew Creek by appropriation and use; defendant claimed 60 inches of said water by appropriation and use for five years before the commencement of the suit. Judgment was rendered for the defendant.

In 1894 Miller & Lux, a corporation, brought a suit against the Fresno Flume and Irrigation Company (No. 8382), praying for an injunction to prevent defendants from diverting the waters of Mill Creek and its tributaries. Plaintiff averred that it owned land in the counties of Fresno and Madera, aggregating some 186,700 acres, situated along and bordering on San Joaquin River, and certain sloughs adjacent thereto, and claimed the waters of said streams necessary for the irrigation and cultivation of said lands by virtue of riparian ownership and usage for twenty years. They stated that defendants proposed to dam Stevenson Creek and Mill Creek, and to divert the waters of said streams from their natural channels, thus preventing them from flowing into San Joaquin River, as they naturally would do, at a point above the land of plaintiff. This suit involved questions of the right of appropriators to take from a stream flowing past riparian lands, by interfering with any tributary flowing into the stream above the land of the riparian owner. Other minor questions were also involved. The case has not come to trial, the defendants having as yet not filed an answer.

In March, 1899, Miller & Lux, a corporation, and the San Joaquin and Kings River Canal and Irrigation Company, filed a complaint against the Enterprise Canal and Land Company et al. (No. 8636), claiming that Miller & Lux were the owners of certain tracts of land bordering on San Joaquin River and its branches, and that they had owned said lands for twenty years past, and that said lands were irrigated and cultivated by means of the waters of said stream. They set up, then, claim as riparian owners. To make this claim more decided they went further, and stated that a great part of these lands (being in fact the wild grass lands) had been overflowed yearly by the flood waters of said stream, thus being rendered exceedingly fertile without need of artificial irrigation. That under their claim and right as riparian owners and appropriators, plaintiffs had constructed and used numerous canals and branches leading out of said river. The San Joaquin and Kings River Canal and Irrigation Company also claimed right to waters taken out of said river in its canal system, by appropriation and usage for twenty-five years past. Plaintiffs claimed that their canals could be easily supplied only by water from San Joaquin River, and that the lands irrigated thereby could be irrigated only from that stream, and claimed the right, by appropriation and usage, to take from said stream 3,350 cubic feet per second of the water there flowing, and claimed that defendants had no right to take any water from the river until plaintiffs' claim had been satisfied. Then returning to its claim as a riparian owner, to have certain lands overflowed by the flood waters of the stream, plaintiffs denied the right of defendants to diminish the flow of the river by the diversion of water, thus preventing this flooding which was beneficial to plaintiffs' lands, and which occurred yearly if the stream was allowed to take its natural flow of water past and over plaintiffs' lands. Having thus set up their rights, plaintiffs stated that some time during the year 1898 the defendant Enterprise Canal and Land Company, constructed a large canal or ditch above the lands of plaintiffs for the purpose of taking water from San Joaquin River, and known as the Enterprise Canal and Land Company's Canal, and that in March, 1899, the defendant actually diverted through said ditch a part of the flow of San Joaquin River, which water rightfully belonged to plaintiffs; and, further, that the water thus taken was to be used in the irrigation of lands not riparian to San Joaquin River. Plaintiffs prayed for an injunction staying defendant from taking said water.

In answer to this lengthy complaint the defendant Enterprise Canal and Land Company, except through a general denial of all the allegations of the complaint, did not deny the riparian rights of the plaintiffs to a reasonable use of the waters of San Joaquin River, but principally based its claim upon the right of outside parties to appropriate water of a stream not covered by claims of other companies or individuals. And here it raised a question of fact, denying that the plaintiffs, Miller & Lux, and the San Joaquin and Kings River Canal and Irrigation Company, had at any times diverted or used 3,000 cubic feet of water per second from said river, or any amount in excess of 480 cubic feet of water per second, and denied the right of plaintiffs to divert more than 480 cubic feet of water per second; and further alleged that there was at all times flowing in San Joaquin River water greatly in excess of this amount, and sufficient to enable both plaintiffs and defendant to take out all the water rightfully belonging to them. It admitted that it did construct said ditch or canal, and did divert water through it, but declared that it had a right to do so, there being in the river water in excess of the amount rightfully belonging to plaintiffs. Of course the question of the amount of water rightfully to be claimed by either party was largely to be answered by evidence. The plaintiffs, as prior appropriators, were of course entitled to the full amount of water they had claimed and actually used; but if there had been water in excess of this amount it would seem that a later appropriator would have the right to take that excess. But there, again, the riparian rights of the plaintiffs came in and complicated the matter. Would the taking out, through a canal above the lands of the plaintiffs, of these waters, have so diminished the stream as to interfere with plaintiffs' riparian rights? This would also seem to be a question to be answered by the evidence. But the matter of the construction of the law came in on their claim to have their lands flooded yearly by the surplus water of the river, without interference by other parties; and it was this claim that the defendant most strongly contested.

It further asserted that plaintiffs, as canal owners and irrigation companies, had no right to engage in farming and cultivation of the soil, using thereon the waters taken from the San Joaquin through their canals. It further averred that the dam of the San Joaquin and Kings River Canal and Irrigation Company between the mouth of San Joaquin River and Sycamore Point was a nuisance, and obstructed navigation. Defendant claimed the right to divert 500,000 cubic inches of water, measured under a 4-inch pressure, and also to receive into its canal or ditch all the overflow water of the San Joaquin claimed by the plaintiffs as riparian to their lands. As will be seen, this was a very important suit, embracing a large number of perplexing questions; yet, withdrawing the case from its side issues, it resolved itself into a conflict between certain riparian proprietors protesting against any diminution of the stream on which their lands were situated, and claiming also as appropriators and actual users of the water, and another appropriator who claimed the right to construct a canal and take water from the stream at a point above the lands of the riparian owners, said water to be used for the irrigation and reclamation of lands which probably could not be otherwise irrigated, but which were not riparian lands. The riparian owners and first appropriators claimed that their necessities and rights cover the normal flow of the stream. The second appropriators claimed that they did not. The riparian owners and appropriators claimed that the overflowing of their lands by the flood waters of the stream was a part of their riparian rights. The second appropriator claimed his right to divert all this flood water into his ditch, to be carried on to certain other lands, there to be used for irrigation. Another defendant sued herein, Jefferson James, set up a similar defense, but in addition claimed riparian rights on Fresno Slough, a natural water course flowing into the San Joaquin. A complaint in intervention was also filed by one Mowrey, claiming riparian rights on the San Joaquin, through Fresno Slough and other branches, declaring that if the overflow waters of the San Joaquin were diverted into the ditch of the Enterprise Canal and Land Company his lands would suffer thereby, through not being annually overflowed; and further, that any diversion of water from the San Joaquin by defendant would so reduce the flow of the river as to deprive intervenor of water to which he was entitled for the irrigation of his land. This very important suit came up for trial and was submitted on briefs April 10, 1900. The court rendered its decision August 1, 1900, the substance of which is as follows:

In an action where the plaintiff claims that his rights have been or are likely to be invaded by some unlawful act on the part of defendants it is first necessary for the plaintiff to show that he has the right which he claims to have, and that by the unlawful act of the defendant he has been or is likely to be deprived of those rights. The evidence shows that the plaintiff, the San Joaquin and Kings River Canal and Irrigation Company, has been diverting water from San Joaquin River by means of a dam thrown across the river. The question, then, presented is, Can anybody ever acquire any right to divert water by means of a dam or otherwise out of a navigable stream? It is recognized as a fundamental principle that no one has the right to do anything which will in any way destroy the navigability of any stream. It is my opinion that said company has not acquired any right, by prescription or otherwise, to divert any water from San Joaquin River, and that, having no right, it can not ask the court to prevent some one else from interfering with that which it never possessed, to wit, the right to divert water from San Joaquin River. It is contended by the plaintiff that this question can not be raised in an issue between private parties. It is not an issue raised between the parties in this action, but it is the failure of proof on the part of the plaintiff, said company, to show that its rights have been or are likely to be invaded by defendant in this action, as it has failed to show that it ever had the right to appropriate water from San Joaquin River. The act of the plaintiff, said company, being unlawful from its inception, it can not found a right on an unlawful act, and I am of the opinion that the plaintiff, the San Joaquin and Kings River Canal and Irrigation Company, is not entitled to recover in this action for any acts complained of on the part of defendants. The plaintiff, Miller & Lux, a corporation, also complains of the defendant in this action for diverting and threatening to divert the water from San Joaquin River at a point above its lands, which it claims are riparian to said river. The evidence and the stipulation of the parties show that Miller & Lux have large bodies of land which are riparian to said river; and the evidence shows that the defendants have diverted and intend to divert the waters of said river at a point above said land. The defendants claim that the lands of James, one of the defendants, are riparian to the said river, and are above the lands of Miller & Lux, and that the defendants, therefore, have the right to divert sufficient water to irrigate their riparian lands. The evidence shows that the lands claimed to be riparian lie on what is known as Fresno Slough, which is claimed by defendants to be a part of the San Joaquin River; but the evidence shows that it is no part of said river; that it is a channel made from the overflow from Kings River during the flood times, and that none of the lands of defendant James are riparian to the San Joaquin River. It follows, then, that the contention of the defendant must fail on that point. The evidence in this case is insufficient to enable me to say at what stage of the water the defendants may divert water from the river without injury to Miller & Lux. When there is an invasion of any right the presumption of law is that an injury has been done, and it devolves upon the defendant to show that by the acts complained of plaintiff has not suffered and will not suffer any injury. In this case there is no question but that the diversion of water from San Joaquin River by defendants has done injury, and it follows that the defendants in this action must show that no injury can accrue to the plaintiffs, Miller & Lux, or to the intervenor, J. J. Mowrey. The defendants having failed to establish that fact, I am of the opinion that Miller & Lux are entitled to a judgment of a perpetual injunction against the defendants in this case; and this applies also to the intervenor, Mowrey, and to the San Joaquin and Kings River Canal and Irrigation Company, in so far as its rights as a riparian owner are concerned in this action. It is therefore ordered that judgment in this case be entered—

(1) That the plaintiff, the San Joaquin and Kings River Canal and Irrigation Company, take

nothing by its action in so far as its claim of right by reason of diversion of water from San Joaquin River is concerned; and

(2) That judgment in favor of Miller & Lux, and intervenor Mowrey, be entered against defendants, enjoining them from diverting any water out of the San Joaquin River; and

(3) That judgment be entered in favor of the San Joaquin and Kings River Canal and Irrigation Company, in so far as its right as a riparian owner in this action is concerned, enjoining each and all of the defendants from diverting any water out of San Joaquin River.

(4) That each party pay its own costs incurred herein.

An act of Congress of the year 1890 makes it unlawful to build any dam or weir, or any other structure which shall interfere with navigation, across or in a navigable river unless the permission of the Secretary of War be first obtained. The plaintiff in this case, the San Joaquin and Kings River Canal and Irrigation Company, did construct a weir across San Joaquin River just below Fresno Slough in the year 1898, and although this weir has a falling section at one end designed to permit the passage of vessels up and down stream, still the company failed to establish to the satisfaction of the court that this new dam, or possibly the old one which was in use previously and which also had a falling section, was not an interference with navigation and a public nuisance. The point made by Judge Webb in this connection is that a right and a claim can not be founded on a wrong, and therefore the company claiming the right to divert water by means of this illegally constructed dam had no right to complain of injury by reason of diversion of defendants. It would seem that the court decided that no one has the right to divert water from any navigable stream by means of a dam or weir which would interfere with navigation. This point in the decision covers broad ground. The riparian rights of the company, and also of Miller & Lux, were apparently sustained and protected. The course is still left open to the enjoined defendants to bring suit against the company and Miller & Lux to determine the extent of their riparian rights, and thereby to ascertain if sufficient water is not left in the river for the filling of the James Canal.

In March, 1900, Miller & Lux and the San Joaquin and Kings River Canal and Irrigation Company filed a complaint against Agnes Borland, setting forth grounds of complaint similar to those in the last suit mentioned (No. 8636), except that the dam and a pumping plant are alleged to have been erected on Fresno Slough, a tributary of the San Joaquin. The questions involved are very similar to those in the case last mentioned. The number of the case is 9004, Fresno County. At the time of submitting this report the defendant had not answered in this complaint.

Case No. 7969, September, 1897, William Lowry brought suit against the San Joaquin and Kings River Canal and Irrigation Company for damages to a crop of grain belonging to plaintiff, caused, as alleged, by submerging it by the waters backed up by defendants' dam across the San Joaquin. The pleadings do not disclose any questions of water rights or irrigation, but in the trial the proofs were largely in that direction. Judgment was rendered for plaintiff for $20,000 damages. An appeal was taken and the case is now in the supreme court.

IN THE SUPERIOR COURT OF MADERA COUNTY.

Madera County was formed from a portion of Fresno County in 1892, and consequently the amount of litigation growing out of water claims on the San Joaquin and its tributaries, as conducted in this county, is comparatively small.

An important case, which at the time my search was made had not yet been tried, is that of the Madera Canal and Irrigation Company *v.* Miller & Lux, the San Joaquin and Kings River Canal and Irrigation Company, and certain individuals. Plaintiff claimed right to use of all waters flowing in Fresno River, and in certain branches and tributaries the waters of which have been diverted into the channel of Fresno River, by right of prior appropriation and use, said appropriation and use dating back over a period of twenty years. Plaintiff also claims riparian rights on Fresno River. Plaintiff states that for some ten years last past it has concentrated said waters thus claimed at a point in the bed of Fresno River above a certain dry channel or waterway known as Cottonwood Creek, and that said waters have been permitted to flow past said dry channel and on down to the lands irrigated by plaintiff, the bed of Cottonwood Creek being higher than that of Fresno River. The complaint then charges defendants with lowering the bed of Cottonwood Creek and with removing plaintiff's dam therefrom, in order to divert into the creek a certain portion of the waters of Fresno River flowing past that point. The complaint prays for an injunction preventing this diversion on the part of the defendants and also asks to be adjudged the owner of, and entitled to the use of, all the waters flowing in the bed of Fresno River. An amendment to the complaint has been filed, setting up the further ground that Cottonwood Creek is a false and unnatural water course and slough. The defendants answer that Cottonwood Creek is a natural water course, and further, that Miller & Lux have riparian rights thereon. They allege that at certain times of the year (probably during floods) a certain amount of water flows from Fresno River into and down said Cottonwood Creek; and they admit that during the year 1899, desiring to divert a certain portion of the waters of said creek and of said river for the purpose of irrigation, they did enter upon said creek, and did propose to divert said water, and posted a notice to that effect at the intersection of Fresno River and Cottonwood Creek, claiming 25,000 miner's inches; and admit that they did commence to enlarge and improve the channel of Cottonwood Creek. They deny that they intended to divert any water from Fresno River which plaintiff has any right to use, and promise that, if permitted to go on with their work, they will not divert any water to which plaintiff is entitled, but merely ask permission to appropriate water in excess of the amount rightfully belonging to plaintiff. Miller & Lux filed a cross complaint against plaintiff, claiming right of way over and along Cottonwood Creek, and the right to construct a canal along said right of way, and charge that subsequent to its acquirement the plaintiff, Madera Canal and Irrigation Company, entered upon Cottonwood Creek and constructed a dam therein, thus preventing defendants, Miller & Lux, from obtaining any water from Fresno River, and pray that plaintiff be enjoined from entering on said right of way or constructing any such dam. The Madera Canal and Irrigation Company answered the cross complaint, reiterating its denial that Cottonwood Creek is a natural water course, and declaring that the dam built by it across its mouth was made only in order to restore a portion of its works which had been destroyed by defendants. A number of amendments to the complaints and answers have since been filed by each side. The California Pastoral and Agricultural Company intervened in this suit, and claims that it has riparian rights along the lower portion of the Fresno River, and that it claims the natural flow of the river in that locality for irrigation of its lands and the watering of its stock. It also claims that this diversion of the water by Miller & Lux would infringe upon its right and prevent this irrigation and watering of the stock. It therefore prays for an injunction, preventing Miller & Lux from making such diversion. The case has not as yet come to trial. Here, as may be seen, all parties claim riparian rights, and rights also by appropriation. The question at issue would seem to be whether Miller & Lux, by enlarging and lowering the channel of Cottonwood Creek, so as to divert a greater amount of water into it from Fresno River, would so reduce the flow of the latter stream as to encroach upon the rights of plaintiff and intervenor, as riparian owners, and upon the former as prior appropriators. The question as to whether or not Cottonwood Creek is a natural water course is also an important one.

The case of Goode *v.* The San Joaquin Electric Company, where damages are claimed by plaintiff by reason of diversion of water above his riparian lands, has been tried, decided in favor of plaintiff, with small damages, and has been settled between the parties without appeal to the supreme court. In this case Goode claimed that the defendant company, by constructing a dam to impound water with which to generate electricity, had shut off his supply from the stream on which he owned riparian lands, and where he had been in the habit of watering his stock. The facts seemed to be established to the satisfaction of the court, and small damages were awarded.

The case of the California Pastoral and Agricultural Company *v.* George D. Bliss et al. (No. 559) came up in 1898. Plaintiff claimed all the water flowing in Chowchilla Creek, both as riparian owner and by right of actual use for ten years past; that defendants claimed some right in said creek, and have within the last five years built a dam across the channel thereof, which practically diverts all the water of said stream, except in times of flood; and that he, by means of canals, carries said water to another locality, and with it irrigates land distant from the channel of said stream. Plaintiff prays for $10,000 damages, and also to be adjudged the owner of, and entitled to the use of, Chowchilla Creek. Defendant George D. Bliss answers that Chowchilla Creek is a natural channel down to the point where it empties into Ash Slough, and that even in times of freshet a large portion of the water of Chowchilla Creek flows into and down Ash Slough, and that the only water which flows down the bed of Chowchilla Creek below that point is either superfluous flood water or water which is discharged in Chowchilla Creek by artificial means, that is, the water which is turned back into the Chowchilla from Ash Slough by the Sierra Vista Vineyard Company for the purpose of irrigating lands owned by it bordering on the Chowchilla. Defendant then sets up a claim to water from the Chowchilla as a riparian owner, and claims that he has maintained a dam, known as Montgomery Dam, across the Chowchilla, from 1878 to 1891, for the purpose of diverting water for the irrigation of his lands, and has turned back into the Chowchilla all water not absorbed in his process of irrigation. He states, further, that ever since 1878 defendant and his grantors have claimed and used said water, adversely to plaintiff, and with plaintiff's knowledge; and that since the erection of a dam by defendant, in 1893, said defendant has continued to divert said water and use it for purposes of irrigation, as he has a right to do; and, further, that if all the water of the stream were permitted to run past this dam in section 29 and down to Montgomery Dam, so called, in section 34, the loss by evaporation, etc., would be so great that, after the proper use of the water by defendant for irrigation, no water would be left to pass on down the channel of the Chowchilla. He adds that during times of freshets there is abundance of water flowing in the Chowchilla throughout its entire course, and prays that the court adjudge defendant entitled to the use of all said water except in times of freshets, and that plaintiff be adjudged entitled to no water from said stream except in time of freshets. This is a case of dispute between two riparian owners on the same stream, and is a question as to how much of the waters of the stream the first owner is entitled to divert and use. Another question also arises, whether his construction of a second dam, farther up the stream, tends to materially diminish the flow of water below his lands. This case illustrates very strongly the benefit that would accrue along the Chowchilla by the storing and proper distribution of its flood waters.

IN THE SUPERIOR COURT OF MERCED COUNTY.

The suit of J. J. Stevenson *v.* San Joaquin and Kings River Canal and Irrigation Company (No. 1767) is apparently the complaint of a riparian owner and canal corporation, entitled to take water from San Joaquin River for irrigation purposes, against another appropriator whose lands, plaintiff claims, are not riparian to the river. The defendant has erected a dam across the San Joaquin above the land of plaintiff, has diverted water thereby, and has not returned it to said river, whereby plaintiff claims to be damaged to the extent of $10,000, and prays for an injunction preventing defendant from interfering with the flow of said stream. Defendant denies the claim of plaintiff to the use of the water, dating back to 1871, and claims prior right to the use of said water, and also declares that plaintiff is estopped from bringing action by section 318, code of civil procedure, and by section 319, Subdivision II, and section 338. This case has not yet come to trial.

IN THE SUPERIOR COURT OF MARIPOSA COUNTY.

In the year 1900 a suit was brought in the superior court of Mariposa County by John R. Hite against the Madera Canal and Irrigation Company. He charges the company with diverting the waters of Big Creek and Raynor Creek so that they no longer empty into the Merced River, on certain forks of which Hite's lands are riparian. He states that prior to the alleged diversion by defendant plaintiff used the waters of the South Fork of Merced River for power and irrigation; that one of the tributaries of said South Fork of Merced River is a stream known as Big Creek, and that one of the tributaries of the said Big Creek is a stream called Raynor Creek. That defendant has a dam on Big Creek, by means of which certain of its waters are diverted. Plaintiff avers that Raynor Creek, when flowing in its natural course, empties into Big Creek at a point below this diverting dam; but that defendant has constructed a ditch from Raynor Creek to a point in Big Creek above its diverting dam, thereby taking its waters and preventing their flowing in their natural course down to the lands of plaintiff; and, further, that defendant has constructed a ditch connecting Big Creek with Fresno River, and now divert the waters of Big Creek into said river instead of allowing them to return to Merced River, of which Big Creek is a natural tributary, and on the South Fork of which plaintiff's lands are situated. He prays for damages, and that defendant be made to desist from such diversion of water. The answer to this complaint states, in effect, that plaintiff abandoned the use of said water about twenty years ago, and has, therefore, lost his claim thereto, and, further, that the defendant has been using continuously said water during the past fifteen years. This is a conflict between a riparian claimant and an appropriator and diverter of water from its natural course, at a point above the land of the riparian owner, by an irrigation company. As both parties also claim certain rights by appropriation and usage, the proof will necessarily have to go toward the establishment of priority of claim and actual use of water, as well as toward the adjudication of the riparian right of the owner. The question arises, also, Can a riparian owner forfeit his right by disuse?

It will be noticed that the majority of these cases are still in court, and the questions raised still undecided. While probably other cases involving similar questions have been tried and decided in other sections of the State, still in the actual trial of each individual suit many new points arise causing it to differ materially from any other on record. It would be extremely difficult, as well as unwise, to attempt to quote decisions already given in cases parallel as to pleadings, but perhaps differing in essential facts from these still unadjudicated cases.

INVESTIGATIONS IN THE FIELD.

My field work consisted in inspecting the canal systems of the companies now taking their water from San Joaquin River, Fresno River, and Chowchilla Creek; in surveying and mapping the streams at and near the sites of the headgates of the several canals; in measuring and photographing the structures, and in gaging the flow of the principal canals (Pls. XXI, XXII, XXIII).

CANALS ON SAN JOAQUIN RIVER.

All the ditches or canals taking water from San Joaquin River are made entirely in cut or excavation, no tunnels or flumes being required in the flat river bottom. The headgates, ditches, stopgates, and weirs generally are of timber, and are constructed in the usual form.

UPPER SAN JOAQUIN RIVER CANAL COMPANY.

The system of this company was designed to irrigate the lands of the higher plains at and near Herndon, belonging to the Bank of California and others, as well as to water the bottom lands of the river between its high banks from Hamptonville as far as points some miles below Herndon. Its headgate was on the left or southeasterly bank of the stream, just above a weir, about 900 feet long, which ran entirely across the river at a point one-half mile below Hamptonville (now Pollasky). The canal and irrigation scheme was a complete failure, the weir being repeatedly broken down in spite of extensive and costly repairs, and the canal cut out and washed away by lateral water courses or through gopher or squirrel holes in the side hill levees. In 1887 the work was abandoned. The area to have been served has since been supplied with water brought through ditches from the Kings River.

PLATE XXI.

FALLING GATE OF NEW DAM NEAR MENDOTA FROM BELOW

DROP GATE ON DITCH NEAR LOS BANOS

REGULATOR GATE ON CHINA CAMP SLOUGH

RUINS OF WEIR ACROSS SAN JOAQUIN RIVER BELOW POLLASKY

IRRIGATION SCENES ALONG THE SAN JOAQUIN RIVER

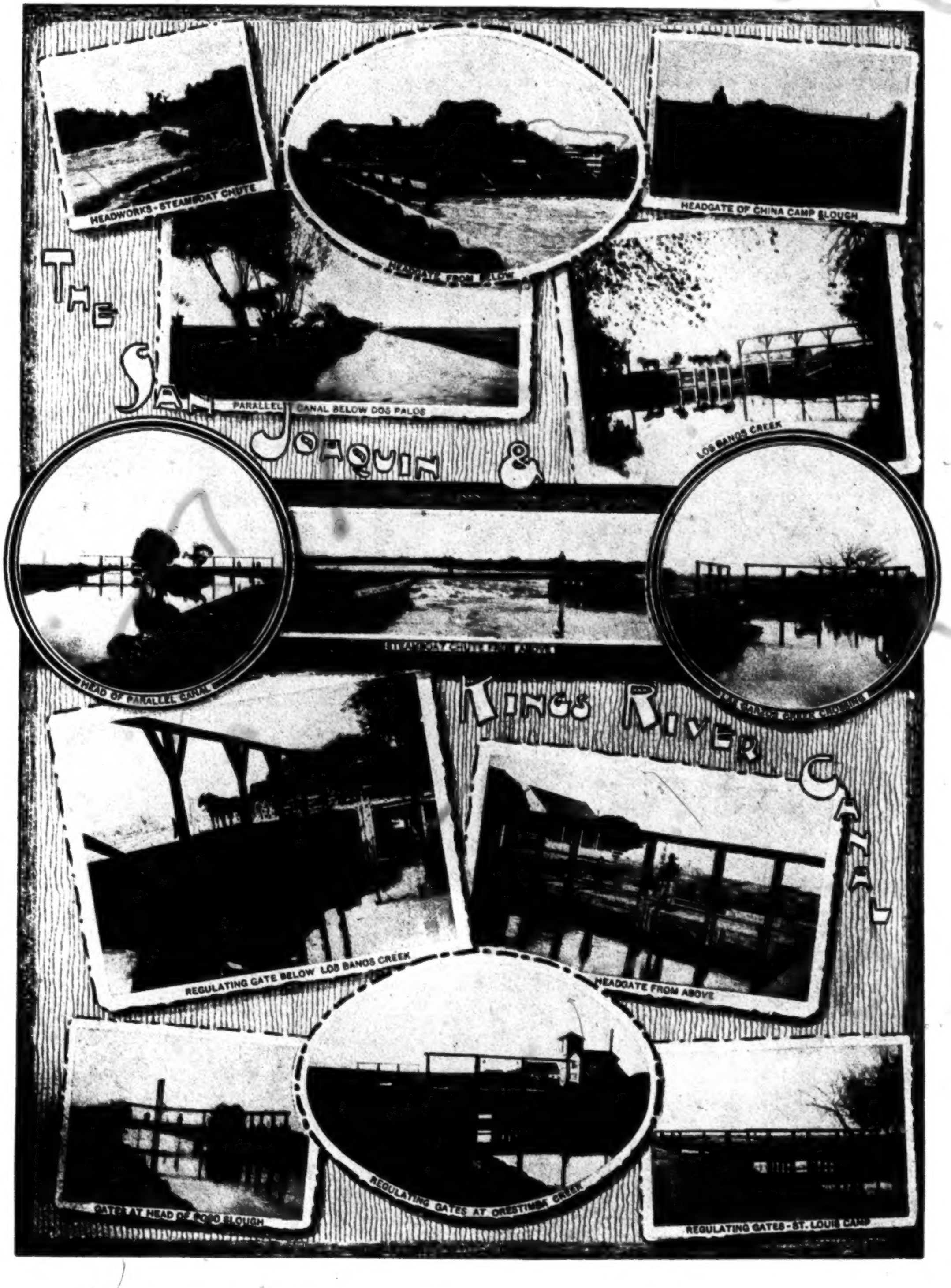
JUNCTION OF SAN JOAQUIN RIVER AND FRESNO SLOUGH

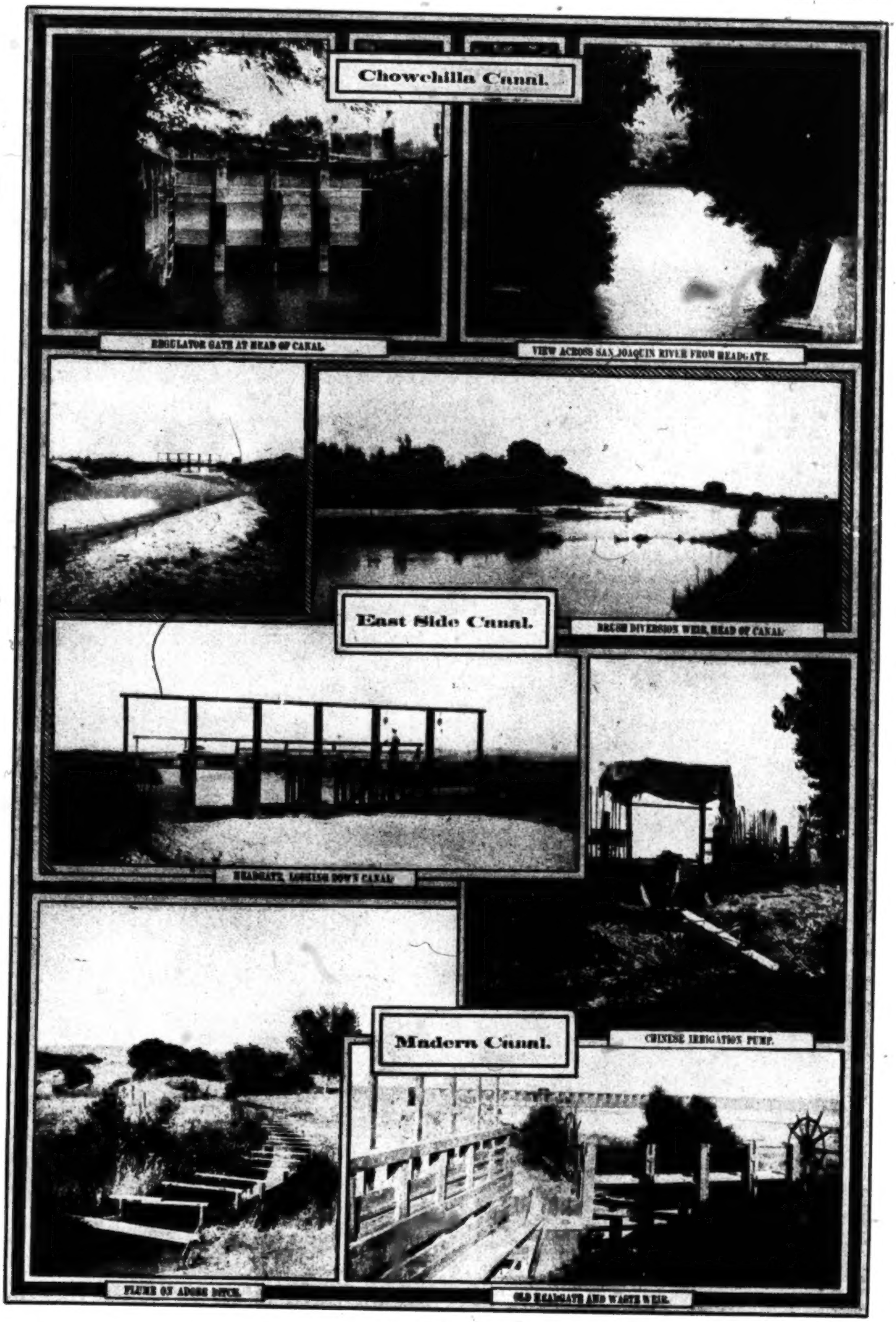
REGULATOR GATE ON JAMES CANAL

DROP GATE ON LATERAL FROM PARALLEL CANAL

FALLING GATE OF NEW DAM NEAR MENDOTA FROM ABOVE

PLATE XXII.


THE SAN JOAQUIN & KINGS RIVER CANAL
HEADWORKS - STEAMBOAT CHUTE
HEADGATE FROM BELOW
HEADGATE OF CHINA CAMP SLOUGH
PARALLEL CANAL BELOW DOS PALOS
LOS BANOS CREEK
HEAD OF PARALLEL CANAL
STEAMBOAT CHUTE FROM ABOVE
LOS BANOS CREEK CROSSING
REGULATING GATE BELOW LOS BANOS CREEK
HEADGATE FROM ABOVE
GATES AT HEAD OF BOBO SLOUGH
REGULATING GATES AT ORESTIMBA CREEK
REGULATING GATES - ST. LOUIS CAMP



Chowchilla Canal.

REGULATOR GATE AT HEAD OF CANAL.

VIEW ACROSS SAN JOAQUIN RIVER FROM HEADGATE.

East Side Canal.

BRUSH DIVERSION WEIR, HEAD OF CANAL.

HEADGATE, LOOKING DOWN CANAL.

CHINESE IRRIGATION PUMP.

Madera Canal.

FLUME ON ADOBE DITCH.

OLD HEADGATE AND WASTE WEIR.

CANAL SCENES.

THE ALISO CANAL.

This canal belongs to Miller & Lux. Its water is used exclusively for the irrigation of wild grasses on lands belonging to that corporation. It has no dam or headgate; the bottom of the canal at its head was made lower than the bed of the San Joaquin, so that no dam or weir is necessary. Construction was begun in 1899, and the canal is not yet finished. It diverts water from the right bank of the river, in sec. 17, T. 13 S., R. 16 E., from which point it has been completed for a distance of 6 miles. It serves about 3,000 acres.

THE CHOWCHILLA CANAL.

This canal is the property of the California Pastoral and Agricultural Company and Miller & Lux, and irrigates their lands, principally for the production of alfalfa, cereals, and wild grasses, and for the pasturage of cattle. It heads below Aliso Canal, in sec. 30, T. 13 S., R. 16 E., and uses Lone Willow Slough for the first 3 miles from the river. The length of the main canal is about 24 miles, with 14 miles of branches. The maximum capacity of the main canal is 120 cubic feet per second, and it serves on an average 8,380 acres each year. The canal was built in 1872, at a cost of $120,000. No water is sold from this canal. It is in use throughout the year, excepting sometimes in August and September, when water is not available. This company made no formal appropriation of water, but holds its right by constant use since 1872. It is now in litigation with George D. Bliss and George D. Bliss, jr. (See Pl. XXIII.)

THE BLYTH CANAL.

This canal is still farther down the river, on the same bank. It is a new construction, made in 1897. It has no dam or weir for diversion, and takes water from the river only in its highest stages. It is used exclusively to irrigate wild grass lands on Chowchilla Ranch, and is the property of the California Pastoral and Agricultural Company. It carries 400 cubic feet of water per second for 0.75 of a mile, and discharges it into the dry trough of the Fresno, where, by means of a series of six strong check levees, 4 to 6 feet high and 1 mile apart, the water is spread over the adjacent plains. About 9,000 acres of wild grass lands thus irrigated furnish pasturage for large herds of cattle. The cost of the canal was $2,400, and that of the checks and levees in Fresno River was $25,000.

THE EAST SIDE CANAL.

This canal is sometimes called the Stevenson & Mitchell Canal. It diverts water from San Joaquin River in sec. 16, T. 9, R. 12 E., about 14 miles southwest of the town of Merced. Water is diverted by means of a temporary brush and sand-bag dam. Its length is about 20 miles. It has a capacity of 200 cubic feet per second, and irrigates a maximum area of 2,500 acres, mostly in wild grasses, alfalfa, and grains. It has six weirs along its length to govern the flow of the water, and also 36 waste gates to provide for the passage of drainage water that comes down the gulches running across the line of the canal. The canal was built in 1887–88, at a cost of $80,000. A suit over water rights between this company and the San Joaquin and

Kings River Canal and Irrigation Company and Miller & Lux, a corporation, is now pending in the courts, and is discussed in this report under the head of litigation (page 245).

THE JAMES CANAL.

The James Canal Company is the successor to the Enterprise Canal and Irrigation Company. Their canal is the upper one on the left or southern bank of San Joaquin River, now in operation, and carries water upon the flat bottom lands of the valley in the region between San Joaquin River and Fresno Slough and on the south of the latter stream. It heads in San Joaquin River about 14 miles above its junction with Fresno Slough, and receives water only during high stages of the river. The main canal is 29 miles long and has 11 miles of branches. It carries 200 cubic feet of water per second, and has served a maximum area of 42,650 acres in grain, alfafa, and grasses. Construction began in 1888, and the canal is not yet completed. The cost has been $35,000. (See Pl. XXI.) This company is at present involved in litigation over water rights with the San Joaquin and Kings River Canal and Irrigation Company and Miller & Lux, a corporation, under the name of the Enterprise Canal and Land Company, and is enjoined by the court from making use of its canal. This litigation has already been discussed.

THE IRRIGATION SYSTEM OF THE SAN JOAQUIN AND KINGS RIVER CANAL AND IRRIGATION COMPANY.

This is the largest irrigation system on the river. (Pl. XXII.) It takes its water from that stream and from Fresno Slough, and by means of them supplies water to the other canals of the system lower down the valley, namely, the Outside Canal, the Parallel Canal, and the Dos Palos Colony Canal, and their branches. Just below the headgate of the "Old Canal" a fine new weir of the latest type has recently been constructed. On its southerly end is a gate or falling dam, which can be lowered flat on the bottom of the stream, thus permitting the passage of boats up and down the river. (Pl. XXI). Some such arrangement is required, as the stream has been declared by the United States a navigable stream far above this point. The old, or main canal, was originally constructed with the idea of using it for navigation as well as for irrigation, but this stream was afterwards abandoned on the ground of expense of construction and operation. The main canal, built in 1872, heads in San Joaquin River at its junction with Fresno Slough (Pl. XXI), and follows down the valley on the west side of the river, for a distance of 76 miles, to a point opposite Westley, in Stanislaus County. The canal has a bottom width of 50 feet, a maximum depth of 6 feet, and a grade of 1 foot per mile. Its estimated capacity is 900 cubic feet per second. China Slough Canal diverts water from Fresno Slough about 1.5 miles above the head of the main canal (Pl. XXI), and empties into the main canal near its head. This canal has about the same dimensions as the main canal. It was constructed in 1897-98. Outside Canal takes water from the main canal on the west side about 2.5 miles below its head, and practically parallels the main canal, at a distance of about 1 mile, for 37 miles down the valley, to Los Banos Creek. It was constructed in 1896-97. Its bottom width is 50 feet, its depth 5 feet, and its grade 1 foot to 3 miles. The capacity is 350 cubic feet per second. Parallel Canal is taken out of the east bank of the main canal 11 miles below its head and about 4 miles below Firebaugh. It follows the line of the main canal on the east side for a distance of 27.5 miles. It is 35 feet wide on the bottom, 4 feet deep, and has the same grade as the main canal—1 foot per mile. Dos Palos Colony Canal, built in 1878, takes water from the main canal on the east side 2 miles below the head of Parallel Canal. It is 11.04 miles long, has a bottom width of 40 feet, depth 5 feet, and runs on a grade of 1 foot per mile. It carries 790 cubic feet per second. Its water is distributed through four branches, 20, 16, 16, and 10 feet wide on the bottom, respectively, and each having a depth of 4 feet. The cost of the canal and its branches was $26,500. The canals of the San Joaquin and Kings River Canal and Irrigation Company are used for the irrigation of grain, alfalfa, and wild grasses. The cost of the entire system of canals and branches was $1,167,805. The company owns no lands other than its right of way, and sells its water to the farmers along the valley, and principally to Miller & Lux, who own the controlling interest in the company.

In direct connection with the system Miller & Lux use Poso Slough, Temple Slough, and Santa Rita Canal as means to take water from San Joaquin River to irrigate their own ranches and pasture lands in the "delta district" below the old canal, some 15 miles below its head.

This company and Miller & Lux have had, during the past few years, considerable litigation over water rights on San Joaquin River and over riparian rights as against rights by appropriation.

This completes the list of canals inspected by the writer which take water from the San Joaquin.

Recently Fresno and other cities of the upper valley have advocated the construction of a ship canal to follow in a general way the line of the river, Fresno Slough, and the lowest line of the valley, past Fresno, toward Bakersfield. It is said that the large canal companies have offered to cooperate in forwarding this scheme. Of course the United States Government would have a controlling voice in this matter as far as any interference with the navigability of the San Joaquin is concerned or affected. Nothing definite has as yet resulted from this proposition.

CANALS ON FRESNO RIVER.

There is but one system of canals deriving its water from Fresno River, namely, that owned by the Madera Canal and Irrigation Company. On this line, running through hilly and rocky country for a portion of its length, there are numerous rock cuttings and many flumes. The canal is usually "in cut" or excavation, and its structures are of the ordinary type. The company makes use of the bed of the river for a considerable distance as its main channel. The company irrigates the Adobe Ranch, about 10 miles easterly from the town of Madera, and some 10,000 or 15,000 acres of land in and near the Howard & Wilson Colony, southerly from the same town. The canal was built in 1873-74, at a cost which has been capitalized at $400,000. (See Pl. XXIII.)

This company is in litigation over water rights with the San Joaquin and Kings River Canal and Irrigation Company and Miller & Lux, a corporation, and also with John H. Hite, of Mariposa County. These cases are discussed under the head of litigation.

CANALS ON CHOWCHILLA CREEK.

THE SIERRA VISTA VINEYARD COMPANY.

This company makes use of the bed of Chowchilla Creek, in the vicinity of Minturn, on the Southern Pacific Railroad, as a storage reservoir, by means of a dam built across the stream from bank to bank, and draws water from above it into the canals on either side of the creek. These irrigate orchards, vineyards, and alfalfa lands belonging to the company.

BLISS CANAL.

In a similar manner, lower down on the Chowchilla, George D. Bliss and George D. Bliss, jr., use two dams in the bed of that stream to fill small canals and irrigate several thousand acres of their ranch in that vicinity. They are engaged in litigation with the California Pastoral and Agricultural Company over riparian rights on Chowchilla Creek. This case is discussed under the head of litigation.

DISTRIBUTION OF WATER AMONG CANALS.

The waters of San Joaquin River are divided among the several canals, not by mutual agreement among the owners or by direction and control of any board having authority or any State official, but simply by being taken under the law prescribing the manner and method of appropriating waters for irrigation or other useful purposes.

No report of the progress of the proposed works nor of their completion is made or required subsequent to the time of recording the appropriation, nor of use of the water claimed at any time. The facts in the case must be ascertained, if at all, by private investigation. The difficulty of obtaining such information can not be appreciated except by one having made the attempt. This data is readily obtained from canal companies in actual operation, in so far as possessed by them, but is out of sight and out of reach in the many cases where records of appropriation have been made but the water not used.

The law places no limit upon the quantity of water which may be claimed in this manner. The statutes prescribing the method of appropriation lead to the condition of "first come, first served," but this is tempered by the necessity of actual use for some beneficial purpose and also by the vested rights of riparian owners.

The Chowchilla Canal, owned by the California Pastoral and Agricultural Company, has made no filing, but claims its rights by virtue of use since 1872. The maximum intake of the Chowchilla Canal is 120 cubic feet per second. With this exception all the canals and companies previously described base their claims for water from the streams enumerated upon claims filed, and, in some instances, upon riparian rights also.

No record of appropriation of water for the Aliso Canal has been discovered by the writer, and its claim is probably based upon the riparian rights of its owners, Miller & Lux.

The Blyth Canal has claimed for its use 1,000 cubic feet (per second?) under a 4-inch pressure. Its maximum intake is 400 cubic feet per second.

The East Side Canal Company claims 345,000 miner's inches under a 4-inch pressure, or 6,900 cubic feet per second. The maximum intake of the canal, claimed for it by its president, is 200 cubic feet per second.

The James Canal Company (formerly known as the Enterprise Canal and Land Company) claims 500,000 miner's inches, under a 4-inch pressure, or 10,000 cubic feet per second. The maximum flow claimed for this canal is 200 cubic feet per second.

The San Joaquin and Kings River Canal and Irrigation Company for its several canals claims from San Joaquin River and Fresno Slough, near the junction of the two streams, an aggregate of 165,000 miner's inches under a 4-inch pressure, or 3,300 cubic feet per second, and, in addition to this quantity, "all the water in the river" at Firebaugh. The maximum intake claimed for their canal is 1,400 cubic feet per second. In addition to these filings Miller & Lux claim their rights as riparian owners to an amount as yet indefinite and unadjudicated. They also use the waste and seepage waters from these canals and the flood waters of the river to fill Poso and Temple sloughs and Santa Rita Canal, for the irrigation of their own ranches in that district, and to flood their wild grass lands adjacent thereto. The maximum intake of all these canals, with the exception of the latter group belonging to Miller & Lux, amounts to 2,460 cubic feet per second, so that we see that on this river, whose mean delivery, according to the recorded gagings of it, is 2,448 cubic feet per second, we have claims made by the owners of canals now in operation aggregating 21,320 cubic feet per second plus "all the water in the river at Firebaugh" plus the riparian rights claimed by Miller & Lux plus the flood waters claimed for their ranches.

We see from this comparison that the mean flow of the river has apparently been reached by the actual consumption on the part of existing canals, and that the claims to water by the companies in actual operation are nearly ten times the amount of the mean flow. Evidently the irrigated area in this part of the State may be extended only by more skillful and economical use of the waters now available, and by extensive storage in the seasons of flood flow. The unfortunate lack in this State of a board of water administration, together with the existing loose laws relating to appropriations, naturally leads to such a condition of affairs as that above described, and to over-recurring litigation.

The Madera Canal and Irrigation Company is the only one taking water from the Fresno. According to the records of Fresno and Madera counties, it has filed on a total of 408,000 miner's inches, or 8,160 cubic feet of water per second. Of this quantity 6,000 miner's inches are claimed from Big Creek and 10,000 miner's inches from Raynor Creek, a natural tributary of Merced River. The flow of the river, as has been shown, at its greatest mean monthly discharge is 1,632 cubic feet per second, so that the amount claimed from this stream and its tributaries is five times the greatest mean monthly flow and nearly forty-nine times its annual mean flow of 167 cubic feet per second. The company claims a maximum intake for its canal of 800 cubic feet per second.

The Sierra Vista Vineyard Company has claimed, by record, from the waters of Chowchilla Creek 24,000 miner's inches, or 480 cubic feet per second.

The waters claimed by George D. Bliss and George D. Bliss, jr., for their dams and canals on Chowchilla Creek, below the Sierra Vista Vineyard Company, are 5,000 miner's inches plus the water rights of their predecessor, J. M. Montgomery, a record of whose claims the writer has been unable to discover.

DISTRIBUTION OF WATER AMONG IRRIGATORS.

In no one of the systems described is the water measured, but, when sold, is dealt out by the superintendent of the canal in amount sufficient to satisfy the irrigator, who is charged so much per acre irrigated. Both the company selling the water and the farmer buying it admit that the water would be used more wisely and economically if sold by measure, but each party to the contract objects to the measurement of water—the company on the ground that the measurement would take too much time and trouble, and the irrigator because he feels that he would not be treated as liberally as at present. The writer does not doubt that the sale of water by measurement would lead to a greatly improved system of conducting the water to the lands and applying it to them, as well as to much more skillful and economical use of it; and would, undoubtedly, greatly increase the duty of water in this district.

The water of the East Side Canal is almost exclusively used upon the Stevenson and Mitchell lands at its extremity. A small quantity is sold to farmers in the vicinity. Each farmer draws off the quantity that he believes his fields need, and pays for it in cash, the charge being $2 per acre irrigated, or $2.50 if the water is not contracted for before the 1st of January. The canals and gates are under the control of a superintendent, but all small irrigating ditches must be constructed by the farmers at their own expense.

The San Joaquin and Kings River Canal and Irrigation Company sells its waters to anyone wishing to purchase them. The public water rates of the company for the year of 1900 are as follows for any part or all the season between July 1 and the following June 30: For alfalfa, $2.50 per acre; for cereals and corn, $2 per acre; for orchards and vineyards, $2.50 per acre; for market gardens, $5 per acre; for water supplied between July 1 and September 1, for second crops of any kind except alfalfa, $1 per acre. Lower rates than these have been established in Stanislaus County by the board of supervisors, but their authority in this respect is now being contested in the courts by the company.

The irrigation water from the San Joaquin and Kings River Canal and Irrigation Company is supplied upon the written request of the irrigator, and under the supervision of the canal superintendent; and is sold at so much per acre, the quantity supplied being sufficient to satisfy the irrigator.

The sale of water by the Madera Canal and Irrigation Company is conducted differently from that of the others. Water rights are sold to subscribers or stockholders at $5 per acre. The owners of these rights then pay $1 per acre per year for the use of the water. Nonstockholders pay $1 per acre for the first irrigation of their land, and $1.50 per acre for each subsequent irrigation. These latter rates for nonstockholders were ordered by the Madera County board of supervisors in 1898. A large number of nonstockholders, owning about 6,000 acres of land, take water at stockholders' rates as before stated, by virtue of the purchase originally of their land with water as an appurtenance thereto. This form of contract just described for water is not satisfactory, either to holders of water rights or to ordinary irrigators. The former complain of their obligation to pay $5 per acre for each acre which they at first contracted to irrigate, whether afterwards they wished to irrigate it or not;

and also that the nonstockholders have been given better terms than they. The nonstockholders complain of a continued deficiency in the water supply.

The James Canal Company leases much of its land to farmers who divide the water among themselves, according to their needs, and pay for the use of the land and water with one-fourth of the crop which they produce. The water sold is not measured in any way.

The form of contract which seems most satisfactory to irrigators in the section of the State visited by the writer is the one which stipulates that, upon notice being given to the canal company, the latter will furnish the required amount of water upon being paid therefor at so much per acre. Other forms of contract more stringent in their exactions on the part of the canal companies are decidedly unpopular, and in some cases have the effect of preventing irrigation.

METHODS OF IRRIGATING.

The lands watered by means of the canals described in this report are remarkably well adapted to irrigation, usually being quite flat, with a uniform slope of 6 to 10 feet to the mile toward the bed of the river. From the main canals in the different systems the water is conducted through branches and laterals to small irrigation ditches upon the farm, where it is received by the irrigators, and applied to the lands under their direct supervision.

In the first days of irrigation in this region, large, high, rectangular check levees were used, but these were found to be not only expensive and very inconvenient for the passage of farm vehicles from one section to another, but also to require much time and a large amount of water to fill them. More recently the universal practice is to use low contour check levees, not more than a foot to eighteen inches in height, and from 10 to 20 feet on the base, enclosing an area of only 5 or 10 acres. These tracts are quickly and easily flooded. The levees do not interfere with the passage of wagons and mowing machines, and may even be plowed over and cultivated. The practice is to introduce the water upon the highest level, flood the area, keep the water moving along, and when a sufficient quantity in a check has been absorbed, to pass the remaining water on to the next and lower check. It is believed to be the best practice to keep the water flowing down and not allow it to stand long in any one area, as then it is more likely to bring alkali to the surface, and also to scald the grain. It is claimed that moving the water tends to leach the alkali from the soil.

In the case of the James Canal, the method of irrigation adopted is to flood with low contour checks, and, in some cases, when wetting pasture fields and wild grasses, to flood without the use of checks. The lands in this locality have a slight and uniform slope.

The Madera Canal and Irrigation Company applies water by the same method employed in the cases previously mentioned—that is, by means of low contour check levees and flooding for grain and alfalfa, and with small rectangular checks for orchards and vineyards, with occasionally the furrow system for the latter.

The Sierra Vista Vineyard Company applies its water to the lands by flooding in an older set of high rectangular check levees, and also in a later set of low small contour checks, this latter system having been adopted in place of the first, upon extension of the irrigation area. The soil is a light sandy loam, quite fertile and favorable to irrigation.

In cases of orchards and vineyards planted on porous soils, lateral absorption, or furrow irrigation, is often practiced.

DUTY OF WATER.

Without an extended study of the results of irrigation from the various canals discussed in this report, it would be impossible to give an adequate treatment of the duty of water in the district covered. However, by drawing upon the experience of irrigators and canal owners, I was enabled to ascertain what it is considered to be in some instances.

The best accessible authorities give the duty of water on most of the canals under consideration to be approximately 160 acres to the cubic foot per second. This would apply to the Aliso Canal, the Chowchilla Canal, the Blyth canals, and the canals owned by the San Joaquin and Kings River Canal and Irrigation Company. On the Madera Canal and Irrigation Company's canal it is estimated to be from 100 to 120 acres per cubic foot per second. However, the loss of water from percolation into the bed of the river and into the distributing ditches is very large, estimated to be one-half of the whole amount taken in. Of course, if this loss could be prevented, the duty would be greatly increased, if not doubled. The largest duty found was on the land under the private canal of the Sierra Vista Vineyard Company. There it was roughly estimated by the proprietors to be 250 acres per cubic foot per second.

ANSWERS TO A CIRCULAR LETTER OF INQUIRY CONCERNING IRRIGATION MATTERS.

During the progress of my investigation of irrrigation along San Joaquin River, I addressed a circular letter to many prominent citizens interested in irrigation, residents of Fresno, Madera, and adjacent territory, and, among other things, asked certain questions.

To these questions I received numerous answers, many oral and some written. I will endeavor to give the full sense of these replies:

(1) Is the present method of adjudicating water rights satisfactory? If not, what method should replace it? It was generally admitted that the present method of adjudicating water rights through the courts is very unsatisfactory. By many, a board of control, or a commission, with full power, was suggested.

(2) How has the doctrine of riparian rights influenced the success of irrigation in this State? And do you suggest any modifications of this doctrine? The unanimous opinion was that the doctrine of riparian rights has worked great hardship to irrigation, and that the law of riparian rights should be "entirely wiped out." Some suggested that the ownership of water should be vested in the State, or in the National Government.

(3) Is the present system of stream control, or lack of it, and of dividing the waters among the several claimants, satisfactory? If not, what form of control should be substituted for the present one? With a few exceptions, the answer was "No, it is not satisfactory, but very unsatisfactory;" and a system of control similar to that in the State of Wyoming was several times suggested.

(4) Should there be a State officer to be known as State engineer; and if so, what should be his powers and duties? Opinions seemed to be divided on this question; the majority, however, were in favor of such an officer, who should have power, under properly established principles of law, to adjudicate water rights.

(5) Should there be a central office of record for claims or appropriations of water, instead of the separate county records, as at present? This question was answered almost without exception in the affirmative; the county records, however, to be maintained as at present, and to be made complete as to the identifications of locality, quantity of water appropriated, its actual use, etc.

(6) What supervision or control should be exercised over water rights which yet remain to be acquired? The opinion was that few water rights now remain to be acquired; but that wherever they exist, they should be held by the State.

(7) As to what should be done to save to the fullest extent and to use the most economically and efficiently the waters at present running to waste, and particularly the flood waters, there was unanimous opinion that it is absolutely essential to the prosperity of the State that the waste and flood waters shall be saved by storage, and dealt out under proper control as needed. As to who should control this system of the conservation of water, the State or the nation, or the two combined, there seems to be no doubt that there should be such control, but some favored the State, some the nation, and some cooperative control by both.

(8) What legislation is needed to define rights to water and to stored water, and to determine the ownership of the waters thus stored? By whom should these laws be enacted, by the State or by the national legislature? Many citizens seemed to have very positive ideas with regard to needed legislation, and particularly as to the abolition of all riparian laws, saying, "That should be the first thing done;" but, as to the course and form of further legislation, either their ideas were not fully matured or else they declined to give them. Many did not favor national legislation on this subject.

CONCLUSIONS.

As a result of my investigation and study of irrigation problems existing in California, and particularly as I have found them in the valley of San Joaquin River, I have drawn the following conclusions:

METHODS OF FILING AND RECORDING CLAIMS TO WATER.

The present method of posting notices and recording appropriations of water, under the existing State law previously referred to, is unsatisfactory to the last degree; in practice it results in great indefiniteness as to the amount of water claimed and uncertainty as to the locality mentioned. It countenances ignorance of water laws and water engineering, leads to obscurity of title, and, in many instances, renders the establishment of the validity and priority of claims almost impossible.

If the present method of making appropriations of water is to be retained, it should be reformed so that every record of appropriation of water shall be perfectly definite and accurate as to location, quantity of water claimed, date of appropriation, size and character of proposed diversion works, and place of use of the water. Also, reports of the time of beginning of the construction of works, of their progress and of their completion, should be exacted.

Periodical reports giving an account of the use of the water, of its amount, etc., should be required to be filed in the office of record, so that any person may at any time by consulting the records ascertain any essential fact relating to claim and use.

ADJUDICATION OF WATER RIGHTS.

The present method of adjudicating water rights in this State is very unsatisfactory. As a matter of fact, the only adjudication which may be had is by means of a suit in the courts. Nearly every decision of the superior court is appealed to the supreme court of the State, and several years time must elapse before a final and conclusive decision is obtained, and thousands of dollars must be expended. Often no new principle is established in this process, simply the relative rights of the contestants. The costs of such litigation have often been enormous. In two counties alone of this State it has been estimated by those well qualified to judge that from $1,000,000 to $2,000,000 have been expended in litigation over rights to water. So long is the necessary delay in the overburdened courts and so heavy the legal expense that many a claimant with limited means is debarred from maintaining his rights, and is forced to abandon their adjudication. Wealthy claimants, by prolonging contests and multiplying costs are sometimes enabled to "beat off" those who are apparently entitled to a decision in their favor.

In place of this chaotic condition of affairs, the writer would recommend that in so far as the constitution of the State will permit, legislation should be had to relieve the courts of this great burden of water litigation and to place the control of the streams of the State in the hands of an administrative board, which shall have authority to adjudicate, upon well-established principles of law, all water claims. The writer deems it essential that the decisions of this board of control shall be final.

INFLUENCE OF THE DOCTRINE OF RIPARIAN RIGHTS ON THE SUCCESS OF IRRIGATION.

The doctrine of riparian rights, as existing in this State, has exerted a most injurious influence on irrigation affairs. It has been the prolific source of litigation; has greatly interfered with and even debarred irrigation enterprises. The laws of the State of California clearly recognize the right to appropriate water from streams and lakes, as is shown by the sections of the statutes previously quoted. And in direct opposition of interest it maintains, under the common law, the riparian rights of private riparian proprietors, as evidenced by many consistent decisions of its supreme court.

The repeal of the doctrine of riparian rights, as construed by this court, affects and relates only to the streams and lakes wholly within the public lands of the United States or in those of the State. The riparian rights of private persons owning land on the banks of streams remain as they were before the passage of the repealing section before referred to; and all such must also, in the future, so remain during the existence of our present laws on the subject.

It seems to the writer, therefore, that the riparian doctrine has been abolished in this State in so far as it can be until all the water shall be again the property of the State or of the General Government, and that waters on a stream can be appropriated for use in irrigation only as subject to the riparian rights, if at all, on that stream.

STREAM CONTROL.

In reality there is at present no system of stream control in the State of California. Anyone who wishes may claim all the water of a stream he may see fit, and may proceed to take out as much as he likes until he arouses a contest with some other claimant, when immediately his case goes into court, to remain there perhaps for years. It can hardly be denied that this state of affairs is most unsatisfactory. In place of this there should be constituted a board of control, of the highest character and ability, which should adjudicate all existing claims to water, and have the authority to carry out its judgments. All water not covered by these adjudications should be declared to belong to the State, and should be controlled and divided for use by this board.

STATE ENGINEER.

The board should appoint a State officer, who might be designated as State engineer, of the highest scientific and technical ability, whose duty should consist in carying out the rulings and decisions of the board in individual cases, such as deciding the validity of particular claims to water, dividing the waters of streams equably among claimants, etc.

WHERE CLAIMS SHOULD BE RECORDED.

If the records of appropriations of water, under the law therefor and as reformed according to my recommendation previously made, should be maintained, there should be not only the record in the office of the county recorder, but also a duplicate thereof in the record book in a central office, as for example that of the surveyor-general or the State engineer, for the convenience of the general public. In this way any person, as for instance a newcomer in the State, could find the exact status of any claim to water on any stream. The convenience of such duplicate record is obvious.

Such appropriations of water and all unappropriated waters of the State should be under the exclusive control of the administrative board previously mentioned. Progress reports of the initiation, prosecution, and progress of diversion works should be regularly made, both to the county and central offices, and annual or semiannual reports of the use of the water so diverted should be required. A lapse of a certain interval should automatically work the forfeiture of the claim. The before-mentioned board of control should, under the law, have the supervision and government in all matters of water rights.

CONSERVATION AND USE OF FLOOD WATERS, AND LEGISLATION THEREON.

For the same reason that the National Government takes control of its rivers and harbors and expends revenues in improving them for the purpose of facilitating navigation and commerce—that is, to benefit the country as a whole and all its citizens—should it assist and encourage the irrigation of all arid and semiarid public lands within our borders, thereby affording homes to our ever-growing population, and increasing the wealth and prosperity of the nation; and stimulating the basic industries agriculture and horticulture—the most important in every country. To this end it should preserve from sale or preemption all available sites for dams and storage reservoirs situated upon public lands, and which may be utilized to irrigate such lands. As far as practicable the flood waters of the streams in arid or semiarid regions should be stored and used for irrigation. In this connection, ample protection should be extended to all forests at the heads of streams that they may forever remain the sources of perennial flow, equally free from overwhelming freshets and seasons of drought.

The National Government should also introduce, through its Agricultural Department, the most advanced and improved methods of irrigation, leading to the most skillful use of water, and to its greatest "duty," and, consequently, to the maximum productiveness of the soil of vast previously arid regions.

In cooperation with the National Government, the State should adopt a simple and effective law to govern the administration and use of all its waters, and the adjudication of all rights thereto acquired.

The common law doctrine of riparian rights seems to sufficiently protect private riparian owners and their use of water from streams, for all ordinary purposes, as for domestic use, milling, etc., with the exception of that of irrigation. And yet the use of water for irrigation in the arid States and Territories is the most important of all. But irrigation is unknown to common law, and legislation in this State is needed to encourage and protect that great and important use of water. The aim in this legislation should be, therefore, to benefit as largely as possible the agricultural population, without injuring the private rights of any riparian proprietors.

The fundamental idea in such legislation, in case the State does not see its way to the acquisition of all existing titles to its waters, is in the writer's opinion, to determine and decide authoritatively what quantity of water each riparian owner and irrigator along each stream is justly entitled to consume. Apparently, upon an equitable adjustment, each would be entitled to take the excess of water left over the just amounts belonging to the other claimants.

A State board of control, having a State engineer of its own appointment for its executive officer, should make such equitable adjustments, considering and fairly treating the claims of irrigators, and respecting the natural rights of riparian and nonriparian owners.

WATER APPROPRIATION FROM KINGS RIVER.

By C. E. Grunsky, C. E.,
City Engineer of San Francisco.

KINGS RIVER.

There is probably no river draining the western slope of the Sierra Nevada whose irrigation system is more worthy of careful consideration than Kings River. Pl. XXIV.

Physical conditions are favorable for the diversion of the river water upon the great eastern plain of the San Joaquin Valley. To the right and to the left the lands commanded are fertile and smooth surfaced, well adapted to irrigation and of great extent. The river has a large discharge, particularly in the months when water is most in demand for irrigation. The early settlers on the banks of the river and in the river delta were appreciative of the advantages resulting from the use of water for irrigation, and the efforts to extend the irrigation system have been persistent and more than ordinarily successful.

It goes without saying that the results would have been still better and that much less litigation relating to water titles would now be pending if operations could have been conducted under adequate and equitable water laws.

Under the somewhat doubtful sanction of law, and in direct contravention of the riparian doctrine, as sometimes interpreted, water has heretofore been taken, and and is being taken, for use in irrigating lands not riparian by anyone in need thereof, or in a position to take advantage of opportunities, for the supply of his own needs and of those of his neighbors. A lamentable absence of recorded facts in the matter of the claiming and the taking of water and the putting of the same to some beneficial use not only renders a study and discussion of water rights and water appropriations difficult and almost impossible without an elaborate and extended inquiry into physical facts and conditions, but, coupled with the uncertainty of being able or permitted to acquire any permanent rights to its use and to receive adequate protection therein, has discouraged all except a few bold and favored ones from putting forth special efforts or taking any considerable financial risks looking toward the development and control of water for irrigating purposes. So it happens that but few of the Kings River canals are managed for profit from the sale of water. Most of them are owned by the landowners.

It was perhaps fortunate for the region now watered by Kings River that the first comers thought the high plains of the valley fit for general agricultural purposes, and particularly for wheat raising, without irrigation, because these settlers, comparing their crops with the luxuriant growth upon the river bottoms, could not but appreciate the contrast, due mainly to the presence of abundant moisture. And when crop failure after crop failure made financial ruin seem certain, there remained nothing to do but to risk all in an endeavor to get water out upon the upland.

So it came about that many were soon ready to make desperate efforts to coax a portion of the river's abundant supply of water out upon the high, dry plain, for when a first effort had met with success and apparently justified the judgment of its promoters others quickly followed, and this despite the fact that under some interpretations of the riparian doctrine no such diversion was permissible, unless, possibly, for riparian lands, without the consent of all lower riparian owners. Whenever the settlers were financially able and water was within reach of their means, even though the means consisted not of coin, but only of plows, scrapers, and willing hands, ditches and canals were constructed. It was thus that Mr. M. J. Church, the projector of the Fresno Canal, and himself the owner of a section of upland, pledged his whole credit to promote ditch construction. And it was the same spirit which a few years later prompted the farmers of the Kingsburg region to pay for their right to take water from the Fresno Canal by constructing one of its most expensive sections, contributing labor, horses, implements, and supplies at a time when they were hard pressed in obtaining the mere necessities of life. It is this spirit which has called into being the extensive irrigation canal and ditch systems of Kings River, which now command over 1,000 square miles of valley land, and actually benefit an area of about 70,000 acres.

Kings River takes rank among the large rivers which drain the western slope of the Sierra Nevada. Only one of these has a larger drainage basin—Kern River, with 2,345 square miles—but the precipitation on the watershed of Kern River being less than that of the Kings River the latter outranks the former when volumes of flow are compared. San Joaquin and Tuolumne rivers are in this class, with drainage basins but little smaller than that of Kings River, but both being farther north, with somewhat greater rainfall. In location Kings River may be classed as fairly central; it cuts across the east-side plain of the San Joaquin Valley to the Tulare Lake about midway between Stockton and the southern extremity of the valley. It is paralleled by the San Joaquin River on the north, about 20 miles distant, and by the Keweah River on the south, about 15 miles away. The breadth of the east-side valley-plain course of the river from base of the foothills to the lake and swamp region is about 30 miles.

The elevation of the valley where Kings River leaves the foothills is about 400 feet above sea level. It falls in 20 miles to about 300 feet at Fresno, and about 86 feet thence to Summit Lake, which, as its name implies, lies on the delta summit which divides the Tulare Lake basin from the Fresno Swamp region to the northward. This delta summit is a very flat ridge built across the valley by the detrital matter brought down by Kings River waters. At its lowest points in the trough of the San Joaquin Valley its elevation is about 214 feet above sea level, and about 30 feet higher than the general level of the lowest portions of the Tulare Lake bed.

WATERSHED.

The watershed of Kings River has an area of 1,742 square miles. It is fan-shaped in form, spreading out as it extends northwesterly from the foothills near Sanger into the Sierra Nevada, of whose crest line the river drains a length of about

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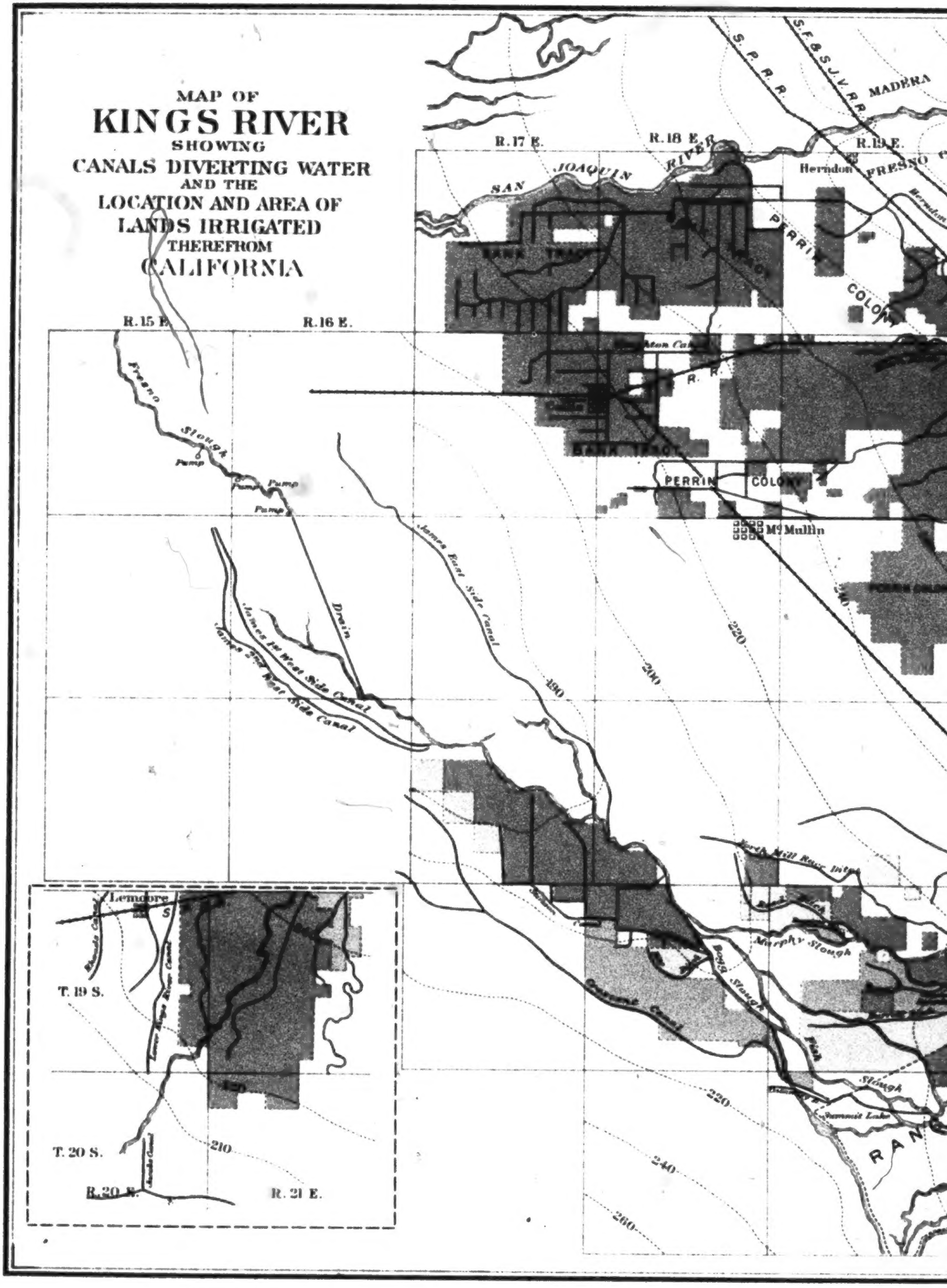
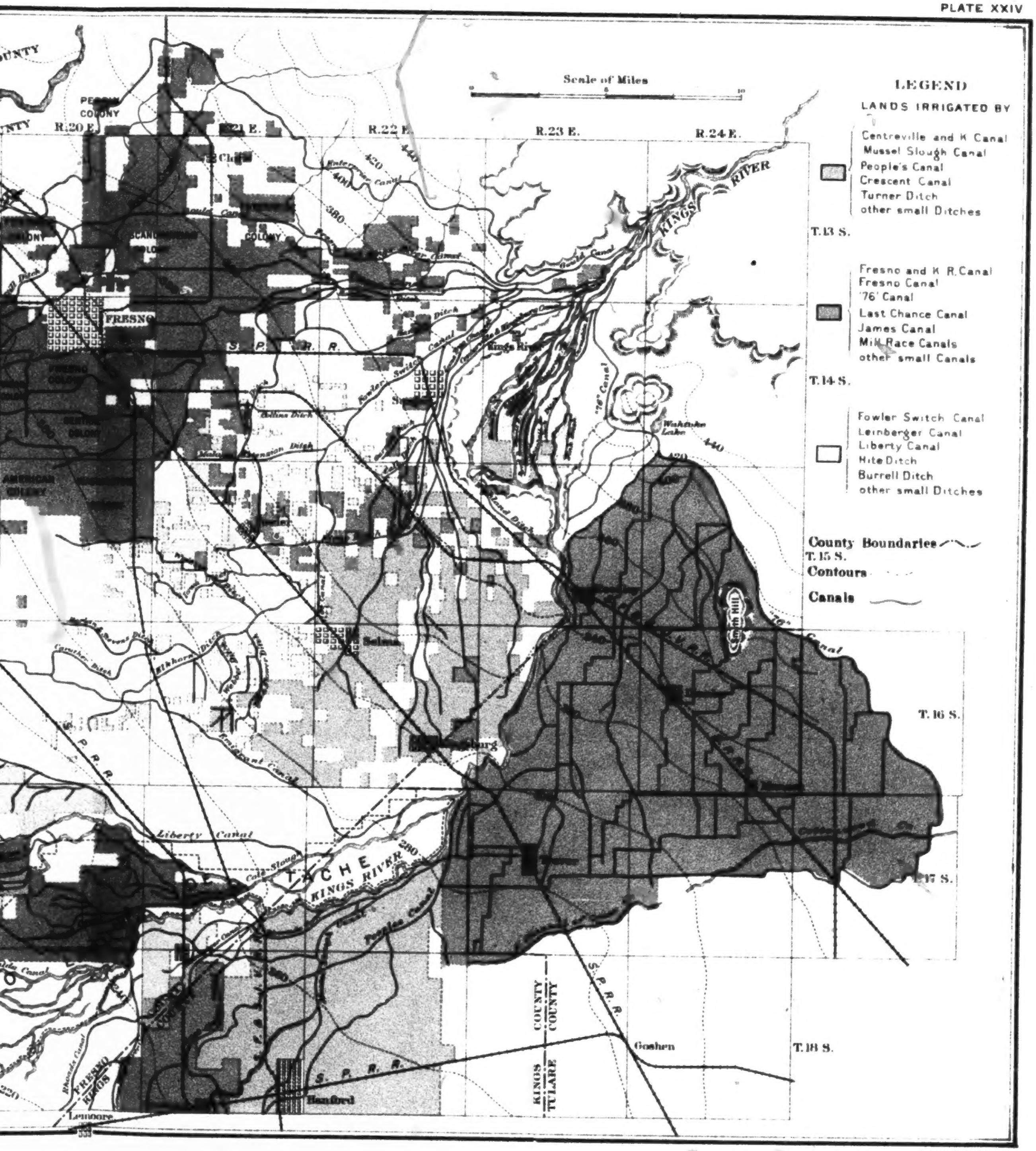

MAP OF
KINGS RIVER
SHOWING
CANALS DIVERTING WATER
AND THE
LOCATION AND AREA OF
LANDS IRRIGATED
THEREFROM
CALIFORNIA
R. 15 E.
R. 16 E.
R. 17 E.
R. 18 E.
R. 19 E.
S. P. R. R.
S. F. & S. J. V. R. R.
MADERA
SAN JOAQUIN RIVER
Herndon
FRESNO
BANK TRACT
PERRIN COLONY
R. R.
M^c Mullin
Fresno Slough
Pump
Drain
James 1st West Side Canal
James 2nd West Side Canal
James East Side Canal
180
200
220
240
260
210
Murphy Slough
Fish Slough
Summit Lake
RANG
Lemoore
T. 19 S.
T. 20 S.
R. 20 E.
R. 21 E.

PLATE XXIV


Scale of Miles
LEGEND
LANDS IRRIGATED BY
Centreville and K Canal
Mussel Slough Canal
People's Canal
Crescent Canal
Turner Ditch
other small Ditches
Fresno and K. R. Canal
Fresno Canal
'76' Canal
Last Chance Canal
James Canal
Mill Race Canals
other small Canals
Fowler Switch Canal
Leinberger Canal
Liberty Canal
Hite Ditch
Burrell Ditch
other small Ditches
County Boundaries
Contours
Canals
R.20 E.
R.21 E.
R.22 E.
R.23 E.
R.24 E.
T.13 S.
T.14 S.
T.15 S.
T.16 S.
T.17 S.
T.18 S.
KINGS RIVER
FRESNO
Kings River
Selma
Kingsburg
Wahtoke Lake
Smith Hill
'76' Canal
Liberty Canal
TACHE
KINGS RIVER
Cole Slough
Peoples Canal
S. P. R. R.
Goshen
Hanford
Lemoore
KINGS COUNTY
TULARE COUNTY
FRESNO
KINGS
AMERICAN COLONY
FRESNO COLONY
CENTRAL COLONY
PERRIN COLONY
SCANDINAVIAN COLONY
Fowler Switch Canal
Collins Ditch
Elkhorn Ditch
Carruther Ditch
Enterprise Canal
Gould Canal
420
440
400
380
360
340
280
220

A. HOEN & CO. BALTIMORE

45 miles, extending from Mount Goddard on the north to Mount Silliman and Mount Brewer on the south. Much of this drainage basin is in the rugged, bare, granite region, at an average elevation of about 5,000 to 7,000 feet. The stream and its branches flow in deep, rocky gorges of stupendous grandeur, and the perpetual snow hangs on the shaded slopes of the highest mountains, some of which rise to heights of 12,000 to 14,000 feet. Very little of the river's mountain drainage basin is habitable; probably more than three-fourths of it is accessible for four to five months only each year. Precipitation on this watershed increases from the base of the Sierra Nevada to near the mountain summit. The average annual fall of rain and snow for the drainage basin of the river is about 25 inches.

VALLEY SECTION OF KINGS RIVER.

To some extent the descriptions of Kings River and its canals, which in compact form are essential to this paper, are a repetition of the descriptions published in Water Supply Paper No. 18 of the U. S. Geological Survey, to which reference may be had for some additional information relating to canal history, to methods of irrigation, duty of water, and the effect of irrigation on subsoil waters.

The upper sections of Kings River are walled in by high mountains and by the foothills of the Sierra Nevada, which open out somewhat within a few miles of the western base of the mountain range. Here the hills, retreating to the right and left, admit patches of valley land, which are pleasantly located upon both sides of the river. The river flows on a coarse cobble bed out of its mountain confine, gradually dropping below the general valley surface so that at what might be considered the eastern edge of the valley plain it flows through bottom lands which lie from 10 to 15 feet lower than the main valley floor. These bottom lands are sharply defined or limited by bluffs, which, after separating to a greatest width of about 4 miles, almost unite 9 miles below the upper end of the bottoms at the so-called "Narrows."

The bottoms, which are only 10 to 15 feet below the general surface level of the main valley above Centerville, are about 60 feet lower than the valley surface at the Narrows. They have an area of about 26 square miles. The height of the bluffs below the Narrows, now close to the river banks, gradually decreases toward the west, permitting the bluffs to gradually merge into the valley surface a short distance below Kingsburg. Westward from this point the river is a bank-building stream; its delta commences and water diversion is effected with ease.

The main river and south-side delta channels drop naturally on easy gradients into Tulare Lake; the north-side delta channels discharge into Fresno Swamp to the northward of Summit Lake; and the waters flow thence northwesterly through the channels and depressions of this swamp along the valley trough to a junction with the San Joaquin River at Las Juntas. The overflow of Tulare Lake, when there is any, takes the same northwesterly course into and through Fresno Swamp.

The main channel of the river from the foothills to its outfall into Tulare Lake has a length of from 70 to 80 miles, according to the stage of the lake. The river through the Centerville Bottoms, has a length of about 17 miles; it falls about 155 feet in this distance, or at the rate of 9 feet per mile. For 14 miles thence to the railroad bridge near Kingsburg the fall is about 1.83 feet per mile. It is about 2 feet per mile throughout the rest of the river's course to Tulare Lake.

The river about the Narrows flows in beds of cobbles; it has ill-defined banks. At high stages it covers large areas of the bottom lands. Below the Narrows its channel is in sand. It is closely confined between the high bluffs already described until it passes Kingsburg, where the bluffs retreat from the river and are gradually lost in the general level of the valley plain. The barrier built by Kings River and extended by it across the trough of the San Joaquin Valley is at its lowest point about 30 feet higher than the lake bed, and 30 miles will barely express its breadth from south to north.

LANDS IRRIGATED.

San Joaquin Valley, with its area of 11,500 square miles, is centrally located in California. It extends in a northwesterly direction from the Tejon Mountains on the south to its junction with Sacramento Valley on the north. The two valleys together form the great Central Valley of California. San Joaquin Valley has a length of 250 miles and an average breadth of over 40 miles. Place the observer where you will in the valley and he has before and about him a vast expanse of land almost as smooth to the eye as the surface of a great expanse of water. Place him a little to the southwestward of the center of the valley, face to the northeast, and he has before him, low down toward the horizon, the distant blue, perhaps snow-capped, Sierra Nevada. If he be thus placed just to the westward of the valley trough, he can look across the great east-side valley plain toward the point where Kings River breaks through the foothills, but the distance is too great to fix clearly the point where the river enters upon its course across the valley. To the right, in the foreground, lies the dry bed of Tulare Lake, which was but recently a great lake, covering at its flood stages about 750 square miles, but now showing encroachment of cultivated areas along its northern, eastern, and southeastern margins, but still presenting several hundred square miles of bare, rough surface, most recently uncovered, having the appearance of parched and cracking clayey soil.

A little farther removed and to the northeastward of the lake area the verdant fields of the Mussel Slough country strike the eye and stretch far away toward the east. Here the broad patches of green of the alfalfa fields are pleasantly diversified with the varying shades of green of the vineyards, orchards, and green fields. Merging into this section is a broad belt of oaks, marking the line from the northeast toward the observer of the main delta channels of Kings River, and still farther north are the broad pasture lands of the Rancho Laguna de Tache.

Somewhat nearer at the left and disappearing in the distance toward the northwest is the Fresno Swamp country, from which all signs of swamp have been fast disappearing, where patches of alfalfa and of grain, occasional groups of trees and buildings give evidence of thrift and energy, and of at least temporary success of the efforts to bring even the freshet flow of the river under control.

Directly in front of the observer, in the foreground of the picture, is a small pond or lake—Summit Lake—which has an elevation about 30 feet greater than the elevation of Tulare Lake bed, and which lies upon the course of the flood-water flow of the main lake. In ordinary seasons, and while Tulare Lake is not full, some of the Kings River flood water finds its way to this lake through some of the delta channels.

From the stand occupied by the observer, his vision can not penetrate to the still greater irrigated districts lying far to the northeast, fairly well covering the portion of the east-side valley plain between Kings River and San Joaquin River, nor to the broad area south of Kings River watered by the great 76 Canal.

All of these lands lie before him, a great smooth-surfaced plain without an undulation, not a hill, mound, or ridge that the eye can detect to break the monotony of the landscape; and all of these lands, embracing an area of about 1,500 square miles, are dependent upon Kings River as a source of water for irrigation, and most of them without the artificial application of water would be unfit for ordinary agricultural purposes.

That portion of the east-side plain of the San Joaquin Valley which extends from the San Joaquin River on the north to the Kings River on the south, and westerly almost to Fresno Swamp, is generally referred to as the Fresno Plains. In the heart of this region is Fresno, a prosperous town of about 15,000 inhabitants, depending almost entirely upon the farming region round about it, which has been made productive by water, and which was a barren, dry, sand waste before its fertility was demonstrated with the introduction of water by irrigation canals.

The foothill drainage of the Sierra Nevada at its eastern margin gullied out channels which carried the freshet run off from the foothill slopes a few miles out into the treeless sandy plain, and there it disappeared. A few of these natural water courses have now been converted into branches of canals, and their flow has been brought under some kind of control. That this arrangement is not wholly satisfactory has repeatedly been made evident by the inundations which periodically occur at Fresno and in its vicinity.

Soils being saturated, the sinks of the creeks can no longer dispose of the same volumes as before and the run off seeks some outfall point farther to the west. When another wet winter or two shall have further inconvenienced the people now residing along the path of these storm waters, some steps will no doubt be taken to make suitable provision for surface drainage.

The slope of the Fresno Plains is greatest near the base of the hills. It falls at first 10 to 20 feet per mile, but soon flattens to a fall of 5 to 7 feet per mile in a general direction from northeast to southwest.

The soil is for the most part a granitic sandy loam, being of heavier character near the hills than near Fresno, and often fine grained enough to be locally classed as white-ash land westward of Fresno. Shallow soil is rarely encountered—most frequently in the "hog-wallow" tracts northward of Fresno, toward San Joaquin River. At the sinks of the water courses the soil is generally of a more clayey character and is deeper than elsewhere in this region. The general fertility of the soils of the region is unquestioned. Hardpan substrata are not everywhere encountered. They sometimes occur, as at points in Central Colony and elsewhere near Fresno, at 1 to 3 feet below the ground's surface, but generally are 10 feet or more below the surface.

The Fresno Plains are watered by the upper north-side group of the Kings River canals. Lands are subdivided into comparatively small holdings, generally 20 to 40 acres in the many colony tracts, and 80 to 320 acres in the rest of the district. Vineyards forming the basis of the great raisin and wine industries, orchards (including citrus fruits, notably near Centerville), alfalfa and grain fields are more or less compactly grouped throughout this region.

As a southwesterly extension of this region the Wildflower country may be named. This is the region originally commanded by the Emigrant Canal, lying to the northward of the delta channels of Kings River. Still farther west are the Liberty and Millrace settlements, and bordering the river, between the main stream on the south and extending beyond Cole (or Murphy) Slough on the north, is the Laguna de Tache Rancho.

The lands of the Wildflower and Liberty districts are for the most part very sandy.

The Fresno Swamp lands, of which the area irrigated with Kings River water is becoming notable, have a soil which may be classed as black vegetable mold. Upon either side of the area, which was originally tule-covered, and extending far beyond the extreme flood limits, is the bad-land strip, strongly alkaline, generally hog wallow, and not yet worth any effort at reclamation.

The Laguna de Tache lands, except such portions as fall within the limits of the alkaline belt, are of recent alluvial formation, deep sandy soils predominating. The marginal portion of the rancho, which, with other lands held under one ownership, has an area of about 68,000 acres, lies in the delta of Kings River, and is traversed by the water courses formed by the overbank flow toward the north and west from the main channel of the river.

South of the river, extending southwesterly from the base of the foothills for a distance of about 15 miles, are the lands watered by the 76 Canal. These extend southward to Cottonwood Creek, and westerly almost to the delta region of the river. This district is cut in two by the only valley tributary of the river, Wahtoke Creek, which is a small foothill stream that drops into Centerville Bottoms from the southeast, and which is crossed where it leaves the base of the hills by the 76 Canal. The soil of the 76 country is somewhat heavier and in places coarser than that of the Fresno Plains. Most of it, however, is still to be classed as sandy loam.

At the western limit of this district and between it and the delta of the river is the broad alkaline belt of waste lands, more or less covered, according to the character of the seasons, with a deep efflorescence of alkaline salts.

Beyond the alkaline strip lies the southern half of the river's delta, the Mussel Slough country, with its fertile alluvial sands, and the broad belt of dark alluvial soil which passes from northeast to southwest centrally through this region. Soils are here deep; hardpan is unknown. The surface of the country lies almost on a horizontal plane, having a fall of only 2 to 4 feet per mile, southwesterly toward Tulare Lake.

Except for the fine growth of oaks in the Centerville Bottoms, and the oaks, cottonwoods, and willows skirting the delta channels of Kings River, the entire region under discussion was originally treeless. The soil was but sparsely covered with nutritious grasses; very little other vegetation was to be seen.

Water, wherever applied, has demonstrated the productiveness of the lands, which without it were barely fit for pasturage.

R

TULARE LAKE.

It is not without interest to note in connection with this inquiry that Tulare Lake has for several years been dry, and that there has been no overflow from it into Fresno Swamp since about 1876.

On the basis of such information as has been obtainable a diagram of the fluctuations of the lake's surface has been prepared, to which, as a general indication of the character of the seasons, a diagram of the rainfall at San Francisco has been added. (Fig. 12.)

It is to be noted that the flood flow of all the San Joaquin Valley streams was exceptionally large in the winters of 1861–62 and 1867–68; also that the rainfall record at San Francisco does not always correctly represent the conditions that prevail in the interior, and particularly toward the south. This is notably true with seasons with less than normal rainfall.

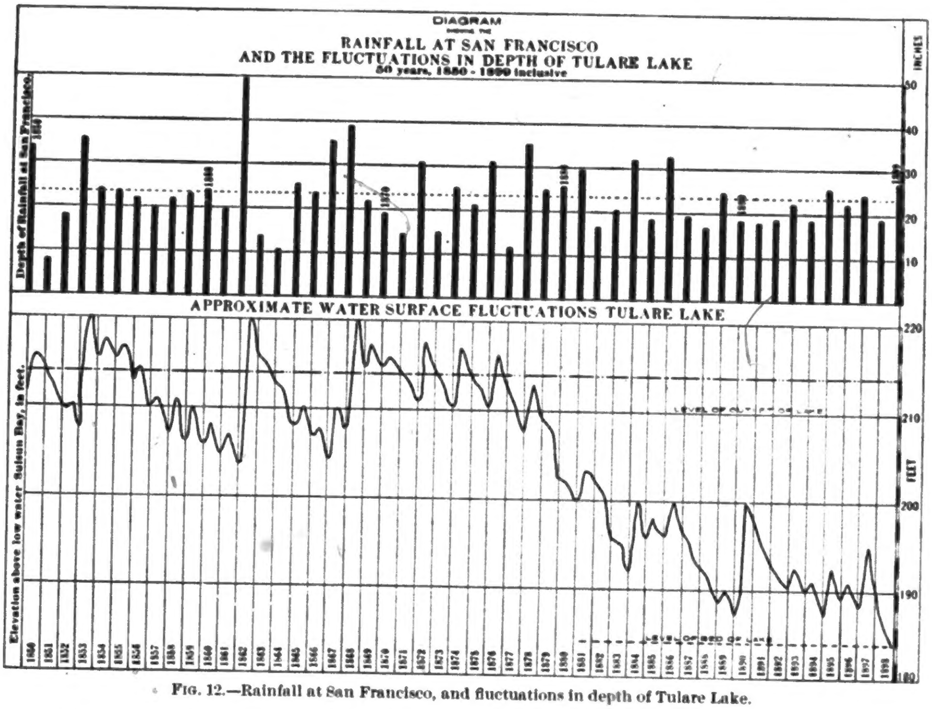


FIG. 12.—Rainfall at San Francisco, and fluctuations in depth of Tulare Lake.

When it is considered that vast areas of land on Kern, Tule, and Kaweah rivers, as well as on Kings River, the lake's principal feeders, have been under irrigation, and that irrigation canal capacities on these streams in the aggregate mount into thousands of cubic feet per second, it is not surprising that the recedence of the lake is generally attributed to the diversion of water for irrigation. There can be no doubt that the use of water for agricultural purposes has had its effect upon the stages of the lake, but when the enormous influx into the lake in a single season—1861-62, when the water surface rose about 16 feet, increasing in area from about 350 square miles to about 750 square miles—is taken into consideration, it appears that after all the prime cause of the recedence of the lake is not the increased use of water for irrigation, but the long interval between seasons of excessive rainfall and the recent long sequence of seasons with precipitation barely normal, or less than normal. It appears, in fact, that the last season in which the streams of San Joaquin Valley were all in extreme flood was that of 1867–68. This is now so remote that a conclusion as to change of climate might almost seem warranted were it not that Indian tradition distinctly points to a still earlier period than that covered by the diagram showing fluctuations, when the lake had all but disappeared, and that the present long sequence of dry years was almost equaled by that of 1853–1861. There is distinct evidence, too, that at some former period of the lake's history there was a protracted low stage (elevation at or below 200), being a period of sufficient length to permit willows to grow to diameters of from 3 to 4 feet.[1]

The occurrence of successive years of scant rainfall, notably the last three seasons, is perhaps serving a good purpose. These seasons afford a better and more satisfactory basis for determining the amount of water that can be relied upon for irrigation, and force upon the water taker the conviction that regulation of use, without expensive and unsatisfactory recourse to the courts, is essential for their protection.

RAINFALL AND CLIMATE.

Rainfall in the district under consideration is not overabundant. About 9 inches represent the mean annual fall at Fresno. It is somewhat less farther to the west and considerably more at the base of the Sierra Nevada. Practically no rain falls from May 1 to November 1, if an occasional unwelcome October shower be excepted, which now and then drives the raisin producer under cover. Very wet seasons, with rain at Fresno in excess of 20 inches, are rare. Those with rainfall below the normal are more frequent. About 10 inches, when favorably distributed throughout the winter and spring months, is considered enough to produce fair crops of grain. Failures of grain crops on unirrigated lands are much more frequent than are good crops.

The summer and fall of the year are dry and hot, temperature frequently rising to about 110° F. in the shade. The nights are rarely oppressively hot. The heat of the region lacks the oppressiveness of the moister climates of the East. In winter the temperature rarely falls below 22°, though temperatures as low as 12° have been recorded. Late spring frosts are dreaded, but are fortunately of rare occurrence. The splendid results in citrus fruit culture to be noted for the vicinity of Centerville (Kings River) are sufficient guaranties of the mildness of the winter season.

As in all copiously irrigated regions, where no effort is made to secure good drinking water, there has been more or less sickness of a malarial type, but in some of the districts which were considered least healthful twenty years ago, as near Centerville, there is now comparatively little complaint.

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[1] See U. S. Geological Survey, Water-Supply Paper No. 17; also Report of Examining Commission on Rivers and Harbors, California, 1890, page 69.

9

THE FLOW OF KINGS RIVER.

Most of the precipitation in the watershed of Kings River is snow. This does not ordinarily melt rapidly until in the warm months of spring. Now and then a warm winter rain overlaps the snow belt, and its volume, added to by the melting snow, produces freshets in the river. These are generally of short duration, and may occur at any time in December, January, February, or March. When the warm weather of spring sets in, the melting snow keeps the river at a protracted high stage generally during April, May, and June, sometimes much later. The maximum flow of the river is not infrequently 20,000 to 40,000 cubic feet per second, and in times of excessive rainfall, as in 1861–62 and 1867–68, it no doubt far exceeds this amount. The low-water stage is reached in September and October, and generally extends into November and December. The river, after seasons of about normal, or less than normal, rainfall, carries about 200 to 300 cubic feet per second at its low-water stages.

Gagings which may stand as close approximations of the flow of the river have been made as follows:

Discharge of Kings River.

Place.	Date.	Discharge.	Authority.
		Cubic feet per second.	
Base of foothills, above all canals	June 24, 1881	6,050	State engineer.
Do	July 26, 1881	1,820	Do.
Do	June 20, 1882	366	Do.
Do	Nov. 19, 1883	266	Do.
Near Kingsburg, between Centerville Bottoms and the upper group of canals.	Jan. 19, 1882	59	Do.
Do	Nov. 22, 1883	119	Do.
Do	Aug. 15, 1885	158	Do.
Do	Jan. 10, 1895	1,830	U. S. Geological Survey.
Do	Mar. 23, 1895	500	Do.
Do	Dec. 2, 1895	356	Do.
Do	Apr. 11, 1896	1,833	Do.
Do	Feb. 11, 1897	905	Do.
Do	Apr. 6, 1897	828	Do.
Do	June 3, 1897	5,959	Do.
Do	July 17, 1897	503	Do.
Do	Sept. 10, 1897	221	Do.
Do	Nov. 3, 1897	465	Do.
Do	Dec. 23, 1897	522	Do.
Do	Apr. 21, 1898	1,658	Do.
Do	May 28, 1898	1,026	Do.
Do	July 26, 1898	305	Do.
Do	Aug. 30, 1898	94	Do.
Red Mountain, above all the canals	Sept. 3, 1895	524	Do.
Do	Nov. 24, 1895	248	Do.
Do	Apr. 12, 1896	1,748	Do.
Do	June 12, 1896	15,941	Do.
Do	Nov. 1, 1896	401	Do.
Do	Feb. 13, 1897	1,021	Do.
Do	Apr. 5, 1897	2,071	Do.
Do	June 1, 1897	8,838	Do.
Do	July 15, 1897	3,313	Do.
Do	Sept. 9, 1897	295	Do.

Discharge of Kings River—Continued.

Place.	Date.	Discharge.	Authority.
		Cubic feet per second.	
Red Mountain, above all the canals	Nov. 1, 1897	552	U. S. Geological Survey.
Do	Dec. 22, 1897	515	Do.
Do	Apr. 20, 1898	4,943	Do.
Do	May 29, 1898	2,672	Do.
Do	July 27, 1898	503	Do.
Do	Aug. 31, 1898	244	Do.
Do	Dec. 21, 1898	2,444	Do.
Do	Apr. 19, 1899	5,409	Do.
Do	May 15, 1899	4,422	Do.
Do	June 3, 1899	3,954	Do.
Do	June 26, 1899	3,049	Do.
Do	Aug. 2, 1899	608	Do.
Do	Sept. 4, 1899	206	Do.
Do	Dec. 8, 1899	458	Do.
Do	Dec. 21, 1899	974	Do.
Do	April 4, 1900	2,035	Do.
Do	May 16, 1900	6,436	Do.
Do	June 19, 1900	5,072	Do.
Do	Aug. 10, 1900	472	Do.
Do	Sept. 4, 1900	405	Do.
Do	Sept. 27, 1900	220	Do.

Based on a rating table prepared by the State engineer, and a record of the stages of water, the flow of Kings River above all canals was estimated for the years 1878–79 to 1883–84, as follows:[1]

Estimated monthly flow of Kings River above the canals, 1878 to 1884.

Month.	1878–79.	1879–80.	1880–81.	1881–82.	1882–83.	1883–84.	Mean, 1878–1884.
	Cu. ft. per sec.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
November	300	400	220	230	470	260	313
December	290	1,440	510	260	340	220	510
January	370	720	870	380	320	430	515
February	870	1,040	2,430	440	340	2,620	1,290
March	1,970	1,120	1,900	1,250	1,050	3,610	1,817
April	4,750	5,230	5,800	3,170	2,220	3,370	4,090
May	5,090	7,120	8,220	9,190	6,700	9,210	7,588
June	3,760	9,540	5,010	6,410	6,730	17,630	8,180
July	1,650	4,800	4,790	2,020	1,460	13,210	4,655
August	380	1,150	650	620	600	3,570	1,162
September	270	370	340	390	480	880	455
October	280	220	250	610	420	900	447

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[1] See Physical Data and Statistics, W. H. Hall, State engineer, 1886, pp. 452, 476.

Based on the gagings of the U. S. Geological Survey, the estimated monthly discharge of the river at Red Mountain, 1896 to October, 1900, has been as follows:

Estimated monthly flow of Kings River at Red Mountain, 1896 to October, 1900.

Month.	1896.	1897.	1898.	1899.	1900.	Mean, 1896-1900.
	Cu. ft. per sec.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
January	11,020	624	624	513	1,706	2,897
February	1,140	6,344	1,170	660	742	2,011
March	7,020	4,408	1,170	2,165	1,802	3,313
April	4,600	9,380	7,820	4,512	2,098	5,682
May	22,100	22,732	6,520	3,568	5,844	12,513
June	18,920	10,580	3,280	6,477	5,131	8,998
July	6,680	4,040	1,310	1,411	1,229	2,934
August	1,212	1,100	400	411	415	708
September	590	480	780	215	301	473
October	510	570	728	384	....	....
November	1,076	2,520	285	638	....	....
December	550	8,348	1,450	991	....	....

As the rating of a stream is more or less affected by changes in the configuration of the river bottom, and no record of these changes is obtainable between gagings, due allowance should be made for this element of uncertainty in using figures from the above tables. They are least reliable for the low-water period.

Inspection of these figures and the great variations from year to year point in the first place to the value of continuous records of this character. These records show an abundant supply of water in ordinary years during the very period when water is most needed by the irrigator—April, May, and June. In these months the ordinary flow is from 5,000 to 10,000 cubic feet per second.

WATER STORAGE.

Water has flowed so abundantly in Kings River that but little inquiry has been made in reference to storage facilities in the river's watershed; and there are no storage reservoirs of note now in service, or under construction, on the river or any of its tributaries. It is not within the proposed scope of this paper to deal with the possibilities for storage which undoubtedly exists at various points in its watershed.

CLAIMS TO WATER.

There seems to be no question that under the statute of appropriation beneficial use is to become the measure of the right acquired to use the water appropriated, and that priority of such beneficial use is to be duly recognized.

Under the statute above mentioned, claims to water are posted at the points where diversions from natural streams are to be made. The notice as recorded is rarely accompanied by any affidavit that it has actually been posted. The notice is recorded in a book kept for the purpose at the county seat. If work commences within sixty days after the posting of the notice and is diligently prosecuted to the completion of the work, the date of posting the notice fixes the date of the taking of the water. No facts, other than the intent of some person to take a certain amount of water, are ordinarily incorporated in the record, and no determination is possible from the record whether the water claimed in the notice is actually taken and put to a benefical use, or whether the canal or ditch has been constructed, and of what dimensions and capacity. No standard form of notice is prescribed by State or county authorities, and the fact of the posting of the notice is not verified except in a very few cases. If a claimant assigns his rights to some one else, and the location of the claim is not stated with precision, it often becomes extremely difficult to identify the claim or claims made for any particular canal; in fact, without the aid of canal owners and a complete search of the records of conveyances, it would be impossible to assign the filings to the respective canals and ditches.

The facts relating to canal construction, to date of completion, to original capacities, to subsequent enlargement, to extensions and kindred matters, do not become matters of record until a dispute between rival claimants to the same water brings the canal owners into court, and even then the findings of the court, based upon the weight and preponderance of evidence and conclusions reached by the courts, should not always be considered final.

Three hundred and fifty-five claims to water and water apportionments, the latter made by the county boards of supervisors acting as water commissioners, could be identified with a fair degree of certainty as being intended to appertain to Kings River or some of its tributaries. Thirteen others were so indefinitely worded that they afforded no reliable clew to the stream or locality where the original was posted. These notices have been abstracted from the records of the three counties, Fresno, Tulare, and Kings. The last-named county was formed a few years ago out of a portion of Tulare County.

By assuming an approximate equivalent for the claims which are indefinite in the statement of amount of water to be diverted, and which fail to specify the dimensions of the canal or ditch to be constructed, it is found that these filings cover an aggregate of about 750,000 cubic feet per second, of which about 100,000 can readily be identified as duplications. A mere glance at the estimated flow of the river (p. 269) is sufficient to show the extent of exaggeration ordinarily indulged in by the water claimant.

The notices of claims to water from Kings River tributaries, so far as they could be identified as relating to this stream, are scattered through the records of three counties, Fresno, Tulare, and Kings.[1]

INSUFFICIENCY OF THE RECORD.

The first claim, recorded on July 28, 1863, was to "all the water" of Fish Creek.

Two years later Hiram Dennis described his appropriation as a "ditch 20 feet wide."

Jesse Morrow, in 1865, recorded a claim to part of the water of Kings River sufficient for the purposes stated in his notice.

Jesse Morrow, William Hazleton, and Harvey Akers, in January, 1866, claimed the "necessary water" for a ditch to commence at the foot of Red Mountain, 2.5 miles above Akers's place, and to irrigate lands below the point of diversion.

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[1] A tabulated abstract of the records of claims to water from Kings River was submitted with the report. It covered 42 pages of type-written manuscript, and is too long for insertion here.

In the following seven claims the amounts claimed can only be conjectured from the sizes of the proposed ditches: Five feet wide, 2.5 feet deep; 20 feet wide; 3 feet wide at bottom; 10 feet wide at bottom, 6 feet deep; 10 feet wide at bottom, 2 feet deep; 50 feet wide and 10 feet deep; 20 feet wide on bottom, 30 feet wide on top, 4 feet deep, and one which merely describes the purpose of the claim "irrigation and watering stock."

The seventh of these, giving top and bottom width of canal and depth, was made by M. J. Church, at the head of the Sweem Ditch, and appears to have been intended as a notice of enlargement.

A claim of water from Wahtoke Creek is for "sufficient water" for irrigation.

John Bensley, on behalf of the San Joaquin and Kings River Canal and Irrigation Company, on June 17, 1871, recorded a notice of a claim to the "first right to water running in Kings River."

The same canal company, five months later, claimed the waters of the river for 15 miles of its course.

Such expressions as "50 feet of water," "all the water here flowing," "20 cubic inches of water," "200 feet under 4-inch pressure," "700 cubic feet under 4-inch pressure," "2 cubic feet running water," "500,000 inches per second under 4-inch pressure," "5,184,000 cubic inches under 4-inch pressure," "all the water in the lake," "2,000 miner's inches of water under a head pressure of 1 foot per second," "200 cubic feet at the rate of 1 linear foot per second," "400 cubic feet of water," "sufficient to fill ditch," are typical of the indefiniteness which is found in these records of intent to take water.

Occasionally a definite amount named in a claim is rendered uncertain by further explanation, such as "8,640,000 cubic inches per second (200,000 inches under 4-inch pressure)," which may be held to mean either 5,000 or 4,000 cubic feet per second.

The location at which the notice is posted, or where the waters are to be diverted, is generally described with fair precision, but sometimes there is no further description than "at the point where this notice is posted," which is now and then made more definite by reference to a pine or alder tree, or, far better, some cabin or residence at least locally known.

There is rarely anything of record that will enable an identification of the claims under which ditches and canals which have been constructed take water. Neither is any record made of the date of commencement of work, nor of its diligent prosecution.

When, by reason of an increased demand for water for any ditch or canal, the same is enlarged and its works are so altered that it can deliver more water, the date of such enlargement and the condition and capacity of the works before enlargement generally live only in the memory of the inhabitants, and where such enlargements have been made it is more than probable that diligence in carrying the work forward to the ultimate condition would be claimed even if years have elapsed between the first construction and the enlargement. Attempts are thus often made to date back to the original, taking the right to full finished canal capacity, when controversy arises with other claimants.

Under these circumstances the recorded copy of the posted notice has but little value, if any, beyond fixing the date at which the original claimant intended to take water and put the same to a beneficial use. To be of real service, even in this respect, the record should not be made at the county seat of the county in which posted, but in some place where all records relating to the same stream are to be found.

Kings River, after all, is a tributary of San Joaquin River—somewhat uncertain of flow in the channels which it sends through Fresno Swamp, and particularly unreliable in the matter of producing an overflow from Tulare Lake—but still at times an important feeder. The question may arise, therefore, as to the extent that riparian ownership on the San Joaquin River may affect the use of water from Kings River. It may seem a remote question to raise, but the principle involved is the same as on a stream known throughout its course by only one name, and is alluded to for the purpose of illustrating how imperfectly the rights of water takers are protected. The bank-land owner, hundreds of miles below, may, perhaps, be presumed to periodically search the records of half a dozen counties to see whether any one intends to take the water he is entitled to have flow past his property. Does he do so? The appropriator hundreds of miles above him, on the other hand, is safe in his taking only after the downstream bank-land owners have all slept on their rights five years or more, and even then only if there be not some minor heir to interfere at a still later period.

The notice of a claim as recorded confers no right to water or to its use. To establish this right it is necessary to furnish, when required by adverse claimants, proof of the taking, of compliance with the law in this respect, and of the amount put to beneficial use.

There seems to be no way—unless by friendly litigation, and this has its dangers—in which the appropriator can have his rights judicially defined.

WATER LAWS AND WATER RIGHTS.

It is not intended to present a full review of the laws governing the right to use water for irrigation in this State, but a brief reference thereto seems essential for a full understanding of the purpose of the notice of a claim to water as well as of the rights of an appropriator and of an irrigator.

Under the act of the legislature passed in 1850, which declares "the common law of England, so far as it is not repugnant to or inconsistent with the Constitution of the United States, or the constitution of the State of California, shall be the rule of decision in all the courts of the State," the common-law doctrine of riparian rights has been recognized and enforced by the courts of the State to such a degree as to often seriously hamper the diversion of water from a stream, even when intended to be used for some purpose more beneficial than any it could serve while flowing in its natural channel to a place of outfall.

The vested rights under this doctrine were recognized when the civil code was adopted in 1872, but they were not defined. In fact, great uncertainty seems yet to exist as to what rights to the use of water the riparian doctrine confers. As sometimes interpreted, giving to the bank-land owner the right to see the water of a stream flow "undiminished in quantity and unimpaired in purity," the doctrine has always been and will always prove a great obstacle to the diversion of water for such purposes as use in mining, irrigation, industrial purposes, and for domestic use.

It does not appear from decisions rendered that the rights conferred and actually vested have yet been clearly defined. The use to which water may be put and the extent of the tract to which the vested right appertains seems to be still indefinite and peculiar to each particular case. No distinction seems to have yet been drawn between lands extending back from the margin of a stream 5 rods and others that extend back 5 miles. The question, too, as to the extent to which any riparian owner may diminish the flow of water in putting it to some use seems to remain unanswered. The intent under the riparian doctrine seems to be that there shall be no material reduction.

The results of the decisions recognizing that under this doctrine certain rights have been vested has been to compel appropriators who had use of water for town supply, for mining, for irrigation, or for other purposes involving an actual diminution of flow in the stream from which water is taken, to negotiate with riparian owners and to pay, often excessively, for a waiver of their vested rights. So long as these rights remain indeterminate, varying with size and shape and topographical features of the riparian tract, such adjustments are made extremely difficult and burdensome to new enterprises.

As the common-law doctrine was not found compatible with the early and soon firmly established customs of the miners who have use for water at points far removed from the natural water courses, these customs quickly established a right to the use of any water not already appropriated, and this custom quickly crystallized into statutory law as follows:

> The right to the use of running water flowing in a river or stream, or down a canyon or ravine, may be acquired by appropriation.
>
> The appropriation must be for some useful or beneficial purpose, and when the appropriator or his successor in interest ceases to use it for such purpose, the right ceases.
>
> The person entitled to the use may change the place of diversion, if others are not injured by such change, and may extend the ditch, flume, pipe, or aqueduct by which the diversion is made to places beyond that where the first use was made.
>
> The water appropriated may be turned into the channel of another stream and mingled with its water, and then reclaimed; but in reclaiming it the water already appropriated by another must not be diminished.
>
> As between appropriators, the one first in time is the first in right.
>
> A person desiring to appropriate water must post a notice, in writing, in a conspicuous place at the point of intended diversion, stating therein:
>
> (1) That he claims the water there flowing to the extent of (giving the number) inches, measured under a 4-inch pressure.
>
> (2) The purpose for which he claims it, and the place of intended use.
>
> (3) The means by which he intends to divert it, and the size of the flume, ditch, pipe, or aqueduct in which he intends to divert it.
>
> A copy of the notice must, within ten days after it is posted, be recorded in the office of the recorder of the county in which it is posted.
>
> Within sixty days after the notice is posted the claimant must commence the excavation or construction of the works in which he intends to divert the water, and must prosecute the work diligently and uninterruptedly to completion, unless temporarily interrupted by snows or rain; provided, that if the erection of a dam has been recommended by the California Débris Commission at or near the place where it is intended to divert the water, the claimant shall have sixty days after the completion of such

dam in which to commence the excavation or construction of the works in which he intends to divert the water.

By "completion" is meant conducting the waters to the place of intended use.

By a compliance with the above rules the claimant's right to the use of the water relates back to the time the notice was posted.

A failure to comply with such rules deprives the claimants of the right to the use of the water as against a subsequent claimant who complies therewith.

Persons who have heretofore claimed the right to water, and who have not constructed works in which to divert it, and who have not diverted nor applied it to some useful purpose, must, after this title takes effect, and within twenty days thereafter, proceed as in this title provided, or their right ceases.

The recorder of each county must keep a book, in which he must record the notices provided for in this title.

The rights of riparian proprietors are not affected by the provisions of this title.

This last section referring to riparian rights has been repealed. But as the section conferred no right its appeal takes nothing from the chapter, neither does it strengthen the cause of the appropriator. No matter what danger may lurk in the doctrine of riparian rights there was very little danger in this section of the code. Whatever rights are, or have been, vested by the doctrine of riparian rights will remain vested rights until, by the right of eminent domain, they are condemned for some higher beneficial purpose.

Whenever water is appropriated for the purpose of being sold for domestic use, or for irrigation and the watering of stock, the supervisors of the counties wherein the water is to be sold, or the town trustees, as the case may be, have the right to establish water rates; but these rates are to be such as afford a reasonable return upon the value of the plant or canal in use.

As a result of the efforts of a large number of advocates of the doctrine that land and the water to irrigate it should be held in joint ownership an irrigation-district law was passed in 1887. Provision was made for the ordering of an election for the organization of districts on petition of fifty or a majority of the freeholders of the proposed district. Lands included in any district were to be susceptible of irrigation from a common source. County supervisors were given power to grant or deny petitions from freeholders desiring to form districts. They could order the necessary election and could amend boundaries. District directors (five in number) were elected from divisions into which the districts were divided. Upon the adoption of plans and the making of an estimate of cost by an engineer bonds were issued and their sale was permitted at not less than 90 per cent of their face value. In voting on the formation of the district and on the issuance of bonds no property qualification was prescribed.

This irrigation-district law has proven a serious obstacle to healthful irrigation development in this State. The machinery for the application of the fundamental principle has proven inadequate. The district law withstood successfully the most vigorous legal attacks, yet the affairs of no district have been so managed as to escape such attacks or to fully satisfy the expectations of the landowners.

There should have been State instead of local control at the very outset of district formation. The sufficiency of the water supply and the extent of the district should have been vouched for by the State engineer or by some department equivalent to a professional department of public works. Only property owners should have had a voice in the formation of the districts and in the issuance of bonds. Voting should, moreover, have been proportional, or nearly so, to the value of the property represented by each voter. Much better results would, it is thought, have been attained if bonds for the construction of the works had been issued by the State and the works had been constructed by the State for the benefit of the district. The State might have been given the right to levy a tax upon the district to pay interest, and it might have retained control of all works of diversion and delivery of water into the districts until such time as it had been recouped for its outlay and all bonds were redeemed.

The law, as enacted, was constantly being evaded. Bonds were sold to third parties in order to be passed from the district to contractors who could not receive them in direct payment for work done. The work for which they were received was contracted for at high prices in order that bonds could be disposed of at values far below par and still compensate the contractor for his outlay. Or works were constructed at private expense with an understanding that they would be bought with district bonds on completion—the law permitting completed works to be thus paid for. Large blocks of bonds, too, were delivered in payment for reputed water rights. Districts were formed on petitions of freeholders who had accepted donations of worthless land, a few acres apiece, in order to qualify as freeholders. In other cases the difficulties of securing an adequate water supply had not been well considered. The districts were misled by low estimates of cost, and after construction had been commenced to make the work already done of value, they had to increase, often double, the bond issue. In other districts the burden of taxation became so great that every effort has been and is being made to evade payment of the incurred obligations.

Of all the districts (over thirty) organized in the State very few are to-day in successful operation. One of these, though not free from troubles of its own, is the Alta Irrigation District, referred to later on. Two others, dependent on Kings River water, had been organized, but are now defunct. These were the Selma district, in which a bond issue was repeatedly defeated, and the Sunset district, whose organization has been declared illegal.

The statutes are silent as to the rights to subsurface and artesian waters, and here again common law becomes the rule of decision. The tendency of recent decisions seems to be to protect a prior user when the subsurface waters flow in a well-defined subsurface channel.

The landowner who prepares his land for irrigation and to whom water is furnished by a canal corporation, is by law granted a continuous right to obtain water from the same corporation. The statute provides:

> Whenever any corporation, organized under the laws of this State, furnishes water to irrigate lands which said corporation has sold, the right to the flow and use of said water is and shall remain a perpetual easement to the land so sold at such rates and terms as may be established by said corporation in pursuance of law; and whenever any person who is cultivating land on the line and within the flow of any ditch owned by such corporation has been furnished water by it with which to irrigate his land, such person shall be entitled to the continued use of said water upon the same terms as those who have purchased their land of the corporation.

WATER-RIGHT LITIGATION.

A search of the court records of the three counties through which Kings River flows has been made, and abstracts of a number of cases, showing the basis of complaint, the answer, and the decree of the court (if judgment has been rendered), are noted in the abstracts which are herewith presented.[1] The abstracts cover 42 cases in Fresno County, 42 cases in Tulare County, and 19 cases in Kings County, and these by no means represent all the litigation relating to water and water rights, but cover only the principal cases in which the rights of ditches and canals to divert water from the river or its branches are brought into question. The list could be supplemented with many more relating to controversies between water consumers and the canal companies which are furnishing the water, and others relating to the validity of the formation of irrigation districts and kindred matters. Time and means have not permitted this inquiry to be made complete.

When the lands bordering upon Kings River in its course from the foothills to the valley trough were sold there was doubt as to whether the riparian doctrine prevailed in this State, and even after being recognized by the courts this doctrine, by reason of the vagueness and uncertainty of the definition of the rights of the riparian owner and of the extent of riparian lands (particularly when the riparian owner himself often claims under this doctrine merely to become an appropriator), was but little heeded when the matter of making a water appropriation was under consideration. In view of the abundance of the water supply, the earliest ditch builders felt secure under the sanction of custom and the language of the statute which permitted the taking of water for beneficial purposes. They preferred to rely upon the fact of the taking rather than upon official records to establish a claim or a right to the use of water as against other takers or often against riparian owners. The demand for better and clearly defined regulations in the matter of acquiring the right to use water has not therefore been as urgently pressed as circumstances would seem to warrant. This has no doubt been also largely due to the fact that appropriators themselves have often preferred to first let sufficient time elapse for the perfection of their own works, with extensions and increased beneficial use, before inviting thorough judicial inquiry and equitable apportionment.

In the upper portions of the valley section of Kings River it flows through the Centerville Bottoms in a network of channels, and all the lands bordering the river appear, under the riparian doctrine, to have some rights that were encroached upon by the canals and ditches taking water from points above or near the upper end of the bottom lands. So, too, the lands bordering upon the delta channels, and, in fact, most of the lands of the river delta, notably the Laguna de Tache Rancho and the large holdings along the southerly bank of the main stream, have under this doctrine been in a position to interpose legal objections and obstacles with more or less success to the taking of water by the canals. It has not always been a question of compelling the canal companies to pay for the damage done by the diverting of water, but the controversies have almost invariably been in the nature of attempts to estop the taking entirely. Proceedings to accomplish this are often postponed until long after the canal is constructed and in service. The enforcement of a decree is then often thought to be an unbearable hardship, and there are canals on the river to-day apparently evading decrees of the courts, which deny them the right to take water.

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[1] The abstracts referred to cover 130 pages of typewritten matter and are too long for insertion.

As a result of the suits brought by the owners of the Laguna de Tache Rancho, who control in the aggregate over 60,000 acres of land in one body, which lies for the most part in the delta region of the river, it was, on July 21, 1885, decreed that the Fowler Switch Canal Company should take no water from Kings River and should fill in the head of its canal. On September 12, 1885, judgment was entered against the Centerville and Kingsburg Canal Company, decreeing that its canal take no water, remove all dams and other obstructions from Kings River, and fill in the head of its canal. It was decreed on November 5, 1885, that the Kings River and Fresno Canal Company should take no water from the river and should fill in the head of its ditch. This decree may have, in part at least, been the reason for the passing of this canal into the hands of the Fresno Canal and Irrigation Company, now controlled by the same persons who own the Laguna de Tache Rancho. A similar judgment was entered against the 76 Canal, or Alta Irrigation District Canal, on November 4, 1889, except as to water for use on the riparian lands irrigated by it in Fresno County. All these decrees, having been affirmed by the supreme court of the State, appear as final judgments. When we still find these canals receiving water at mean to high stages of the river it may be inferred that they do so on tolerance.

It would seem more logical and more equitable to have laws so administered that either these canals could never have been built or that, having been built, their rights to surplus water should have been more clearly defined.

As above stated, one of these canals, the Kings River and Fresno Canal, is now owned by the same persons who own the Fresno Canal and the Laguna de Tache Rancho, so that in its case, plaintiff having absorbed the defendant, the court decision may never be enforced.

In the case of the Fowler Switch Canal the decree has been rendered ineffectual, in a measure at least, by floating the water right of the Emigrant Ditch, in part, to the head of the Fowler Switch Canal, it having happened that the Emigrant Ditch Company was more fortunate than the other canal companies in securing a court decision, on February 3, 1890, denying the owners of the Laguna de Tache Rancho a cause of action, and decreeing that the Emigrant Ditch has a capacity of 190 cubic feet per second. Branches of Fowler Switch Canal extend into the region commanded by the Emigrant Ditch and connect with the branches of the latter, but the head of Fowler Switch Canal is about 33 miles above the original head of the Emigrant Canal.

Of the decisions rendered by the courts the following may be noted as of more than local interest:[1]

August 10, 1875, the Kings River and Fresno Canal Company was by a decree of court denied the right to use Centerville branch of Kings River.

November 5, 1885, a judgment was rendered requiring the Kings River and Fresno Canal Company to remove from the river, and from the Centerville channel thereof, all dams and obstructions placed therein by that company, and to fill the head of its ditch so that water can not flow from the river or from said channel into the ditch, and enjoining them from diverting any of the waters of the river. Affirmed by supreme court.

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[1] Decisions are here noted as they relate to each canal in chronological order, being repeated for each canal to which they relate.

August 10, 1875, the Fresno Canal and Irrigation Company is granted, as against the other claimants, the right to use Centerville channel of Kings River as a part of its canal system.

January 8, 1900, the Fresno Canal and Irrigation Company received judgment against the Alta Irrigation District (76 Canal), declaring it to be entitled to 1,000 cubic feet of water per second. An appeal is pending.

March 16, 1892, it was decreed that the Fresno Canal and Irrigation Company is entitled to divert 100 cubic feet of water per second, and no more, until the Lower Kings River Canal is supplied with 159 cubic feet per second, and that its acts in diverting 500 cubic feet per second in August, September, October, November, and December, 1877, 1878, and 1879, were unlawful. Appealed, and appeal dismissed.

March 6, 1892, a judgment was entered declaring the Fresno Canal and Irrigation Company entitled to divert 100 cubic feet of water per second, and no more, until the Last Chance Canal is supplied with 190 cubic feet per second. Appealed, and appeal dismissed.

September 12, 1885, judgment was entered decreeing that the Centerville and Kingsburg Irrigation Ditch Company is required to remove all dams and other obstructions placed or maintained by that company in Kings River, and enjoining it from diverting any waters from the river or in any manner interfering with the full flow of its water.

February 25, 1900, the Centerville and Kingsburg Irrigation Ditch Company is awarded 600 cubic feet per second, subject to the prior rights of the Peoples Ditch Company to 274 cubic feet per second, of the Lower Kings River Water Ditch Company to 182 cubic feet per second, and of the Last Chance Water Ditch Company to 217 cubic feet per second. It is also decreed that the so-called Arkansas Flat people have the right to divert from Kings River into China Slough, through the Centerville and Kingsburg Ditch, 19 cubic feet of water per second; but this right seems also to be subject, under the decree, to the prior rights of the other canals. On appeal.

July 21, 1885, a judgment was entered against the Fowler Switch Canal Company decreeing that that company be forever enjoined from diverting any water from Kings River and from obstructing or in any manner interfering with the flow of its waters. Affirmed by the supreme court.

February 3, 1890, the Emigrant Ditch Company was given judgment against the owners of the Laguna de Tache Rancho, who attempted to prevent its taking water, and it was decreed that its canal had a capacity of 190 cubic feet per second. Affirmed by the supreme court.

April 17, 1885, a judgment was entered debarring the owners of the Laguna de Tache Rancho from diverting from Kings River or Cole Slough any more than 30 cubic feet per second until the Lower Kings River Ditch Company is supplied with 100 cubic feet per second. Appealed and judgment affirmed.

July 21, 1885, the owners of the Laguna de Tache Rancho obtained a judgment against the Fowler Switch Company decreeing that the canal company be forever enjoined from diverting any water from Kings River and from obstructing or in any manner interfering with the full flow of the waters of the river. Appealed and judgment affirmed.

September 12, 1885, the owners of the Laguna de Tache Rancho obtained a decree of court against the Centerville and Kingsburg Irrigation Ditch Company for $1,000, and requiring it to remove dams and other obstructions from Kings River, and enjoining it from diverting any water from the river. Appealed and appeal dismissed by the supreme court.

November 5, 1885, the owners of the Laguna de Tache Rancho obtained a decree of court against the Kings River and Fresno Canal Company requiring it to close its ditch and enjoining it from taking water. Affirmed by supreme court.

May 3, 1886, the owners of the Laguna de Tache Rancho obtained an injunction restraining the Last Chance Water Ditch Company from dredging out and enlarging the lower channel of Kings River at and immediately below Cole Slough, and from erecting and maintaining any dam or obstruction across the channel of Cole Slough, or from doing anything that would interfere with the free flow of water in Cole Slough.

October 4, 1897, in an action entitled the Lower Kings River Water Ditch Company *v.* The Peoples Water Ditch Company, it was decreed that the Laguna de Tache Rancho is entitled to divert 30 cubic feet of water per second before any of the parties to this action are entitled to any water.

November 4, 1889, the owners of the Laguna de Tache Rancho obtained a decree enjoining the 76 Land and Water Company from diverting from Kings River any of the water of said river for sale and for distribution and use upon any lands whatever, except such as are riparian lands, on said river in Fresno County. (Lands are described.) Appealed and judgment affirmed by the supreme court.

January 8, 1900, Alta Irrigation District was declared entitled to divert 500 cubic feet of water per second, subject to a prior right of Fresno Canal to 1,000 cubic feet per second, excepting in the months of October and November, in addition to a certain quantity which the Fresno Canal and Irrigation Company may be obliged to permit to flow down the river for use of the Peoples Ditch Company.

September 19, 1893, a judgment was entered against the 76 Land and Water Company (Alta Irrigation District) decreeing to the Peoples Ditch Canal a priority of right to 200 cubic feet of water per second from Kings River, and awarding the Peoples Ditch Company a judgment for $11,869 and costs. Affirmed by the supreme court.

May 9, 1900, a judgment was entered by stipulation, according to which it was decreed that the Last Chance Water Ditch Company has a right prior to any of the 76 Land and Water Company (Alta Irrigation District) to 217 cubic feet of water per second from Kings River, except during the months of September and October of each year; and further decreeing that after the Last Chance Water Ditch Company is supplied with this water, measured in the SE. ¼ of sec. 30, T. 16 S., R. 23 E., that subject to this right the 76 Land and Water Company (Alta Irrigation District) is entitled to 750 cubic feet per second.

Based on a complaint dated July 20, 1898, a judgment is entered by agreement between the 76 Land and Water Company (Alta Irrigation District) and the Lower Kings River Water Ditch Company, according to which it is decreed that the Lower

Kings River Water Ditch Company has a prior right to 182 cubic feet of water per second from Kings River, and that subject to this right the 76 Canal is entitled to 750 cubic feet per second.

September 19, 1893, a judgment was entered decreeing a priority of right to 200 cubic feet per second to the Peoples Ditch Company as against the claims of the 76 Land and Water Company and the Alta Irrigation District, also giving judgments against the 76 Land and Water Company and the Alta Irrigation District for $11,869 and costs. Affirmed by supreme court.

July 23, 1895, a judgment was entered, based on an agreement or stipulation, according to which a priority of right to a certain amount of water—25 to 100 cubic feet per second (not intelligible in the abstract at command)—is conceded by the Peoples Ditch Company to the Lower Kings River Water Ditch Company.

October 4, 1897, a decree was entered declaring the Peoples Water Ditch Company entitled to 200 cubic feet per second, subject to a prior right of the Laguna de Tache Rancho to 30 cubic feet per second, and of the Lower Kings River Water Ditch Company to 100 cubic feet per second.

May 15, 1899, the Peoples Ditch Company obtained judgment against the owners of the Laguna de Tache Rancho, who endeavored to prevent the taking of water by the canal, and for 450 cubic feet of water per second. Affirmed by supreme court November 10, 1893.

February 25, 1900, the Peoples Ditch Company is decreed to have a right to 274 cubic feet of water per second prior and superior to the right of the Arkansas Flat people to divert 19 cubic feet per second through the Centerville and Kingsburg Canal, and prior to the right of the Centerville and Kingsburg Irrigation Ditch Company to divert 600 cubic feet per second. On appeal.

May 3, 1886, a judgment was entered enjoining the Last Chance Water Ditch Company from placing or maintaining a dam or in any wise obstructing the full flow of water in the head of Cole Slough, and from enlarging the channel of Lower Kings River at the head of Cole Slough.

March 6, 1892, a judgment was entered declaring the Last Chance Canal to be entitled to 190 cubic feet per second, subject to the prior right of the Fresno Canal and Irrigation Company to 100 cubic feet per second. Appealed and appeal dismissed.

April 13, 1897, the Last Chance Water Ditch Company is adjudged to be the owner of 250 cubic feet of water. (Last Chance Water Ditch Company *v.* The Upper Leinberger Slough Company et al.)

October 5, 1897, a decree was entered declaring that when the quantity of water flowing in the river is in excess of 300 cubic feet per second, the Last Chance Water Ditch Company is entitled, at all times, as against the Peoples Water Ditch Company and the Lower Kings River Water Ditch Company, to divert into its canal all of such excess, less a pro rata contribution toward 30 cubic feet per second, to which the Laguna de Tache Rancho is given a prior right, until the excess equals 100 cubic feet per second.

February 25, 1900, the Last Chance Water Ditch Company was decreed to have a right to 217 cubic feet per second prior and superior to 19 cubic feet per second which the Arkansas Flat people may divert through the Centerville and Kingsburg

Canal and prior to the right of the Centerville and Kingsburg Irrigation Ditch Company to 600 cubic feet per second. On appeal.

May 9, 1900, a judgment, based on agreement between the Last Chance Water Ditch Company and the 76 Land and Water Company (Alta Irrigation District), decrees to the Last Chance Water Ditch Company the priority of right to 217 cubic feet of the water per second from Kings River; subject to this prior right it was decreed that the 76 Land and Water Company (Alta Irrigation District) is entitled to 750 cubic feet per second.

April 17, 1885, a judgment was entered denying the owners of the Laguna de Tache Rancho the right to divert more than 30 cubic feet of water per second from Kings River or Cole Slough until the Lower Kings River Water Ditch Company is first supplied with 100 cubic feet per second.

March 16, 1892, a judgment was entered declaring the Lower Kings River Canal entitled to 159 cubic feet of water per second, subject to a prior right of the Fresno Canal and Irrigation Company to 100 cubic feet per second. Appealed and appeal dismissed.

July 23, 1895, a judgment was entered on the basis of an agreement or stipulation with the Peoples Ditch Company, according to which priority of right to a certain amount of water—25 to 100 cubic feet per second (not intelligible from the abstract at command)—is conceded to the Lower Kings River Water Ditch Company.

October 4, 1897, a court decree was entered declaring the Lower Kings River Water Ditch Company to be entitled (subject to a prior right of the Laguna de Tache Rancho to 30 cubic feet per second) to 100 cubic feet per second, as against any claim to water by the Peoples Water Ditch Company and the Last Chance Water Ditch Company.

February 25, 1900, the Lower Kings River Ditch Company is decreed to have a right to 182 cubic feet of water per second prior and superior to the right of the Centerville and Kingsburg Irrigation Ditch Company to 19 cubic feet per second, and to 600 cubic feet per second (the 19 cubic feet per second belonging to the Arkansas Flat people). On appeal.

Based on an action commenced July 20, 1898, a judgment was entered by agreement with the 76 Land and Water Company (Alta Irrigation District), according to which a prior right to 182 cubic feet of water per second from Kings River was decreed to the Lower Kings River Water Ditch Company, and subject to this right it was decreed that the 76 Land and Water Company (Alta Irrigation District) is entitled to 750 cubic feet per second.

June 4, 1898, by stipulation of the Crescent Canal Company with the Stimson Canal Company, a judgment was entered by the court that the Cresent Canal should have the first right to 213 feet of water for each foot, 50 inches of water flowing and measured under a 4-inch pressure.

June 4, 1898, by stipulation of the Stimson Canal Company with the Crescent Canal Company, a judgment was entered by the court allowing the Stimson Canal Company to construct a headgate in a dam or levee at or near the North Fork of Kings River, but not to deprive the Crescent Canal from first taking the quantity of water which it has been accustomed to take, to wit, 213 feet for each foot, 50 inches of water flowing and measured under a 4-inch pressure.

In the actions A. Heilbron et al. *v.* Peoples Ditch Company, 1883; A. Heilbron et al. *v.* Last Chance Ditch Company, 1883, and A. Heilbron et al. *v.* Emigrant Ditch Company, 1883, it was decreed that the causes of action were barred by the statute of limitations. A. Heilbron et al. were the owners of the Laguna de Tache Rancho.

The decisions above quoted do not represent all the litigation between the appropriators of water from Kings River, as numerous cases were of minor importance, or decisions were reversed, or had no bearing upon the right of the canals to water, or are still pending.

A lack of consistency in these court decrees is apparent. In cases where appropriators of water have not acquired rights by the statute of limitations the riparian owners seem to be successful in obtaining decrees restraining appropriators from diverting the waters of the stream, even when the riparian owners are themselves diverting the water from natural channels in order to make it accomplish a greater duty in watering crops than it could accomplish if left to flow undisturbed in natural channels. But after decrees are entered and confirmed, enjoining canal owners from taking water, they are followed by other decrees apparently conceding water to the same canals and fixing the priority of use as between the several canals.

These decisions are rendered at the close of long and expensive trials. The facts relating to canal construction, to canal dimensions and capacity, and to periodical enlargements are not of record, and the courts are not provided with impartial technical aid to ascertain or verify facts which are presented by the host of witnesses marshaled by plaintiff and defendant. Even the experts do not agree, and in many cases the best expert testimony is outweighed by evidence erroneously classed as expert. The expert, moreover, is generally not called until the cause of action has been clearly defined, and he must deal with facts as he then finds them. He is rarely in a position to follow up the full history of canal building, so as to present a correct sequence of such facts as are essential in passing upon the merits of rival claims to water.

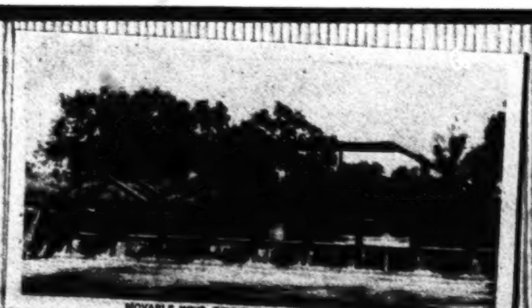
KINGS RIVER CANALS.

The first irrigators using Kings River water were some of the settlers on the Centerville Bottoms—Hiram Dennis, Harvey Akers, Jesse Morrow, John Carey, and others, who severally, and occasionally in partnership, constructed small ditches for the irrigation of favorably located tracts of land. Most of these early works were badly wrecked by the great floods of 1867–68, and it has been found difficult to trace the history of these earliest ditches, many of which have been out of service most or all of the time since then. The most permanent in character seems to have been the Centerville Canal or Ditch, for the enlargement of which J. B. Sweem filed a notice of a claim to water August 5, 1869. The Sweem water right and the Centerville Ditch both passed soon after into the hands of M. J. Church, the projector of the Fresno Canal.

SAN JOAQUIN AND KINGS RIVER CANAL.

The most comprehensive project for the utilization of Kings River water of the early days of irrigation development in this region was that of the San Joaquin and Kings River Canal Company, which proposed not only to divert San Joaquin River water upon the west-side plain of the valley, a project which has been carried out,

PLATE XXV.


MOVABLE WEIR, REYNOLDS SLOUGH, FROM BELOW

MOVABLE WEIR, REYNOLDS SLOUGH, FROM ABOVE

DAM IN COLE SLOUGH AT HEAD OF EMIGRANT CANAL

HEADGATE OF EMIGRANT CANAL

SCENES ON CANALS ALONG KINGS RIVER

HEADGATE OF HANKE DITCH

HEADGATE OF LIBERTY CANAL

HEADGATE OF 76 CANAL

MURPHY SLOUGH AT HEAD OF REED DITCH

WEIR, HEAD OF MURPHY SLOUGH, FROM ABOVE

but who were farseeing enough to recognize the value to their enterprise of controlling also the water to Kings River and other streams to the south as well as the overflow of Tulare Lake. Their project was on too stupendous a scale to be carried out in its entirety with the means at command, but it indicates that the value of effecting a control of the water available for irrigation was early appreciated. From the notices recorded it is inferred that they claimed the first right to water running in Kings River. The records also indicate their intent to dam up Lake Tulare, using the same as a reservoir and availing themselves of the flow of Kings River sloughs, the Mussel Slough, Four Creeks, Deer and Elk creeks, Bayou River, Tule River, White River, Poso Creek, Kern River, Kern River sloughs, Goose Lake, Buena Vista and Kern lakes, and Buena Vista Slough. It was also proposed by the same company to utilize by appropriation the waters of Summit Lake and its tributaries; also to convert a 15-mile stretch of Kings River, near the point where it leaves the foothills, into a reservoir for storage purposes. As ultimately constructed, the canal of the San Joaquin and Kings River Canal Company received its supply of water from San Joaquin River at the point where the same is joined by Fresno Slough. Kings River contributes to the supply of the canal but little water—only that which through north-side delta channels reaches Fresno Swamp, and succeeds in passing the numerous north-side Kings River irrigation canals, and even this water, as it flows only at times when the San Joaquin River is furnishing an abundant supply, can hardly be construed as being an important contribution to the water taken by that canal.

The idea of utilizing Tulare Lake as a storage reservoir for irrigation purposes was revived a few years later, when the legislature passed an act authorizing the formation of a west-side irrigation district. The studies for this district relating to water supply and canal system were made and all preliminary steps for its organization were taken. The bonds authorized, however, were never sold, and no district works were constructed.

SANGER FLUME.

Sanger Flume and Lumber Company uses a certain amount of Kings River water, diverted from the stream far up the mountains, to float its lumber to a delivery at Sanger, about 14 miles east of Fresno. The water of the flume—about 15 to 20 cubic feet per second—is, by agreement with the Fresno Canal and Irrigation Company, turned into the Lone Tree Channel, one of the branches of the Fresno Canal.

DITCHES OF CENTERVILLE BOTTOMS.

Earliest among the users of Kings River water for purposes of irrigation were the settlers in the Centerville Bottoms. The bottom lands were naturally well, and frequently excessively, watered by the network of high and low water channels in which the river flows through the bottoms and to a final concentration in a single channel near the lower end of the bottoms at the Narrows. Control of water in these channels and its diversion were readily effected. A few cobbles piled into a channel to increase the flow in another, even a high-water slough, has frequently been the basis for thereafter claiming it as a ditch or canal. Some of the ditches now in use in the Centerville Bottoms are of recent construction. In the case of some of these newer canals, their owners, claiming that they were constructed for the benefit of the same lands that were formerly watered by some of the old ditches, construe them as entitling the present owners to the original rights, in some cases even when, after the great freshet of 1867–68, years of disuse have intervened.

RICE DITCH.

This is an old ditch which has its head at the dam of the Centerville and Kingsburg Canal. Its water is supplied through a culvert in the westerly end of the dam. The ditch has a width of about 10 feet, having a capacity of 10 to 20 cubic feet per second. The ditch has a length of about 2 miles.

JACOBIE DITCH.

This is a small ditch, less than a mile in length, on the south side of the main channel of Kings River, about a mile below the head of the Centerville and Kingsburg Canal. It was built within the last few years, has a width of about 3 feet, and supplies water to about 200 acres of land.

THE DUNNIGAN-BYRD DITCH.

This ditch was built in 1892 and receives water from one of the high-water channels of Kings River which connects Moody Slough with Patterson Slough. The ditch is about 2 miles long and about 3 feet wide, and has a capacity of about 5 cubic feet per second. A small cobble dam is maintained in the channel, from which it diverts water. The lands served by it have an area of about 300 acres.

HANKE DITCH.

This ditch was constructed in 1895 to irrigate lands previously watered by the old Barton Ditch, the headgate of which was washed out in 1867–68. The ditch receives water from the south bank of Moody Slough, which is one of the channels of Kings River. The ditch headgate is located somewhat farther downstream than the original headgate of the Barton Ditch. The ditch is about 12 feet wide, carrying about 25 cubic feet of water per second, with a possible extreme capacity of twice this amount. It is the largest of the ditches irrigating lands in the Centerville Bottoms. The lands served by it have an area of about 1,200 acres.

CAMERON DITCH.

This ditch was constructed about 1885. It receives its water from the west side of Patterson Slough and occupies a position nearly parallel with the Hanke Ditch, but from one-fourth to one half mile farther east. It has a width of about 6 feet and carries about 10 cubic feet of water per second. Its owners claim that its right to take water dates back to 1865, when Hiram Dennis filed a notice of intention to construct a ditch 20 feet wide. It has a southwesterly direction, is a little over a mile long, and supplies water to about 300 acres of land. A brush dam is maintained in Patterson Slough at its head to assist in the diversion of water.

DENNIS DITCH.

This ditch is reported to have been built in 1859. It takes water from the west side of a high-water channel which leaves Patterson Slough near the head of the

Cameron Ditch and connects Patterson Slough with Outside Slough. A brush dam is maintained in Patterson Slough to divert water into the high-water channel, and a smaller dam in this channel—which is about 10 feet wide—turns the water into the ditch. Dennis Ditch has a width of about 5 feet and a flow of from 5 to 10 cubic feet per second. It has a southerly direction, is about 3 miles long, and supplies water to about 300 acres of land.

BYRD DITCH.

This ditch is reported to have been constructed in 1858. It receives its water from the same channel that supplies water to the Dennis Ditch, having its head about half a mile below the head of the latter. The original diverting works were destroyed by the freshet of 1867–68, and the ditch fell into disuse. It has been in service again since 1885. Its capacity is about 5 to 7 cubic feet of water per second. It has a width of about 5 feet, flowing in a southerly direction for about 3 miles, paralleling the Dennis Ditch and irrigating about 300 acres.

THE NEW JACK DITCH.

This ditch was built in 1898, receiving its water from Outside Channel about 4 miles below the point where Outside Channel separates from Patterson Slough. It is a short, small ditch, about 3 feet wide and 1 mile long, irrigating about 160 acres of land lying between two of the branches of Outside Channel.

MITCHELL DITCH.

This is a small ditch. It receives water from a branch of Outside Slough and serves a few acres of land in the same vicinity as that served by the Jack Ditch. The width of the ditch is about 3 feet and its length about 1 mile.

FINK CHANNEL.

By this name the eastern arm of Outside Slough is known. Its course is almost due south for a distance of 5 miles, near the eastern limit of the Centerville Bottoms. The water was first diverted from Outside Channel at the head of this water course in 1868. A brush dam in one of the several channels into which Outside Channel separates at the head of this water course turns the water into it. The inflow into Fink Channel is controlled by a headgate 12 feet in width. This gate is of recent construction. Fink Channel is about 20 feet wide, and carries from 25 to 30 cubic feet of water per second. It supplies the Jack Ditch, Fink Ditch, and a number of other small ditches with water. This channel was formerly known as the Kincaid Ditch. About 1,000 acres are reported as being served with the water of this channel.

JACK DITCH.

This is a ditch supplied with water from Outside Channel through the Fink Channel. Its head is about 2 miles below the point where Outside Channel separates from Patterson Slough on the easterly side of Fink Channel. The ditch has a southwesterly, then southerly, course, being a little over 2 miles long. Its bed width is about 5 feet.

FINK DITCH.

This is another one of the small ditches to which water is supplied through Fink Channel. It receives its water on the eastern side of the channel, about a mile below the head of the Jack Ditch. It has a southerly course and is about 2 miles long.

KINGS RIVER AND FRESNO CANAL.

This canal is reported to be now owned by the same parties who own the Fresno Canal. It is probable that decisions of the courts adverse to the claims of its original owners have forced a combination with what was originally a rival enterprise. As elsewhere noted, the canal company is enjoined from taking any water from Kings River, but still remains in service. The canal is favorably located for effecting diversion, and it commands that portion of the great east-side plain of the San Joaquin Valley which extends from Kings River northward to the San Joaquin River. This canal is the upper north-side canal from Kings River, the point of diversion being about 6 miles above Centerville (now Kings River). Its water is carried into the region northeasterly from Fresno, serving lands westward from the base of the foothills for a distance of about 20 miles. The bed width of the canal is generally 16 to 24 feet. The flumes in which it is carried over Red Bank and other creeks are 16 feet wide, with sides 3 feet high. The capacity of the canal is about 300 cubic feet per second. By a gaging made this year at a time when the canal was being filled with water its flow was found to be 260 cubic feet per second. As the water was probably still rising while this gaging was being made, it is not a perfectly reliable index of canal capacity.

The canal is owned by an incorporated company, and its water is sold at rates fixed annually. Owners of stock are preferred purchasers of the water, and receive the same at two-thirds its cost to other irrigators. The rates in the past have been $50 per cubic foot per second to stockholders and $75 per cubic foot per second to others. No attempt is made to measure the water delivered to consumers. The canal superintendent apportions it to the latter and private ditches according to the number of cubic feet per second to which each is entitled.

The canal construction dates back to 1872, and the first cost of the main canal is reported to have been $50,000. The area irrigated, or sufficiently benefited by the waters of the canal to be classed as irrigated, has been reported at about 15,000 acres.

FRESNO CANAL.

The construction of the Fresno Canal antedates that of the Kings River and Fresno Canal about two years. This canal supplies water to the irrigated region in which Fresno is centrally located. The head of the canal is about 4 miles above Centerville, near the northern margin of Centerville Bottoms. (Fig. 13 A.) It receives water from the Centerville channel of Kings River, across which a cobblestone and brush dam is maintained. A short westerly cut through the gravelly soil of the bottoms takes the canal to a depression at the base of the north-side bluff, which depression was formerly known as Chambers Slough. This has been converted into a canal section by the construction of a levee along its south bank to a point a little over a mile from the head of the canal. The canal capacity is, and has been in the past, in a large measure dependent upon the safe height to which this embankment along Chambers Slough permitted water to be raised. Leaving Chambers Slough the canal is cut into the higher bank land and lies in an excavation having a greatest depth of about 10 feet and a bed width of about 50 feet. The main canal in its course thence westerly toward Fresno holds a direction probably with the greatest slope of the country, falling 5 to 10 feet per mile. Advantage was taken of a number of natural water courses, into which the canal water was dropped. Canal construction commenced in 1870 with the posting of a notice of a claim to water "to be taken from Kings River at the upper end of Sweem Ditch, 20 feet on the bottom, 30 feet on top, 4 feet deep." This claim was made by Mr. M. J. Church, who a month later acquired a two-thirds interest in the Sweem Ditch. The Sweem Ditch was a small ditch, the construction of which seems to have been commenced in 1870, and it was intended to increase the flow of what was then known as the Centerville Ditch. Its upper section was enlarged and became the head section of Fresno Canal. In 1872 a regulator, or headgate, was constructed in the head of Fresno Canal, and in the spring of 1874 a small cut on the line of the present Long Cut was completed from the Centerville Ditch to the lower sections of the Fresno Canal, on which work had meanwhile been pushed to the limit of the means of the projector of the work. This small connecting ditch is reported to have had a bed width of only 5 feet on a grade of 5 feet to the mile. As the alignment of a part of the older Centerville Ditch was in time to become the alignment of a section of the Fresno Canal, and because it seemed desirable to secure the water rights

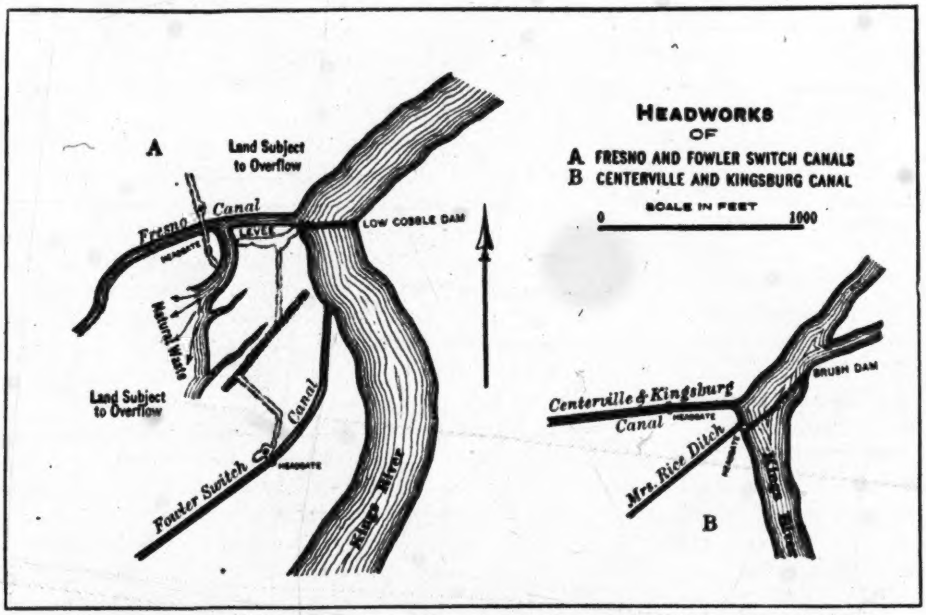

HEADWORKS
OF
A FRESNO AND FOWLER SWITCH CANALS
B CENTERVILLE AND KINGSBURG CANAL
SCALE IN FEET
0
1000
A
Land Subject to Overflow
Fresno Canal
HEADGATE
LEVEE
LOW COBBLE DAM
Natural Waste
Land Subject to Overflow
Fowler Switch Canal
HEADGATE
Kings River
Centerville & Kingsburg Canal
HEADGATE
BRUSH DAM
Mrs. Rice Ditch
HEADGATE
Kings River
B

FIG. 13.—A, headworks of Fresno and Fowler Switch canals; B, headworks of Centerville and Kingsburg Canal.

acquired by the Centerville people, arrangements were made to obtain control of the corporation known as the Centerville Canal and Irrigation Company, and a transfer of their ditch property was made to the Fresno Canal and Irrigation Company. This was in 1874. As soon, however, as the settlers near Centerville realized what their officers were doing the demands for just treatment at the hands of the Fresno Canal and Irrigation Company were made so emphatic that those who were entitled to water in the older ditch were granted water rights in the new canal for their lands in perpetuity, without limit as to quantity and free from expense assessments. About 1,500 to 2,000 acres of land are thus covered. In 1875 it became necessary to enlarge the cut westward from the Centerville Ditch, and to this end labor was bargained for with farmers who wanted water delivered to their lands through Lone Tree Creek. Thirty-five water rights were issued to farmers, who completed this canal section in June, 1875. Meanwhile other parties had become financially interested in the enterprise. It was not profitable, however, at the outset, and, from various causes, a transfer of the property in 1876 to the Bank of Nevada became necessary. The bank soon sold it to the original projector, on the execution by him of a long-term note, for $28,000. By this time a number of large holdings of land had been subdivided and sold in small tracts and had become dependent upon the canal for water. Notable among these early colonies are Central Colony, owning 2,640 acres, and Temperance, Church, and Nevada colonies, each owning 640 acres. These colonies, together with the Pioneer Vineyard on the F. T. Eisen tract, soon demonstrated the great productiveness of the Fresno sand plains, and the development of that region was rapid during the next decade. The sale of water rights had progressed steadily, so that in 1884 about 400 had been issued or bargained for, and their price had increased from $200 to $800 each. Later their price was fixed at $1,600 by the canal management.

A water right, as issued by the company, is the right to use one-thousandth part of the flow of the canal not in excess of 1 cubic foot per second on a specified tract of 160 acres. The canal company reserves the privilege of issuing 1,000 water rights without enlarging the main canal. Each purchaser of a water right agrees not to use the water or permit it to be used on any other land than that for which the right is purchased, nor to permit the water to run off upon contiguous land, or in any other way to run to useless waste, and he agrees to return surplus waters to the main canal or a branch thereof. Each water right remains subject to an annual expense assessment, which ranges from $80 to $100. Water is delivered without any attempt at measurement to each irrigator at any point on the company's ditch system that he may select. No transfer of a water right can be made except with the land which it covers. Each purchaser of a water right grants to the canal company the right of way for ditch and canal purposes through any lands lying in the same township as the tract for which water is bought, and concedes to the company the right to use his private ditch provided the company does not use it so as to interfere with the delivery of his water. The purchaser of a water right further obligates himself to pay to the canal company annually an agreed sum (this has usually been $100), and in default of payment for thirty days to forfeit his water right. The water-right agreement further sets forth that the company shall not be responsible for deficiency in water supply caused by drought, insufficiency of water in the river, hostile diversion or obstruction, forcible measures, or temporary damage by floods or other accidents, but that it shall use and employ all due diligence at all times in restoring and protecting the flow of water in its canals.

The structures on the canal do not deserve extended notice. They are all made of timber. The original regulator has been replaced by a second one, constructed about 1884. It consists of a substantial framework of heavy timbers, spaces between vertical posts being closed by vertical sliding gates. From the headgate an embankment of cobblestones, gravel, and sand extends northward across Centerville Bottoms to a connection with high land, and prevents destruction of the upper section of the canal during freshets. The diversion of water into the head of the canal is effected by means of a brush and cobblestone dam, the maintenance of which in the past has not been expensive. Along the line of the canal, wherever necessary to prevent excessive erosion or where required to turn water into a branch ditch, light timber weirs are in use. Most of these consist of two side or bulkhead walls and a floor, usually placed a little below the grade of the canal, and a line of vertical posts supported by braces from below. Spaces between posts are closed to the desired height either by fixed horizontal boarding or by movable drop timbers or boards. The impression which the whole work gives is that of haphazard management, the result of which is not, however, entirely unsatisfactory.

The control of the canal long ago passed out of the hands of Mr. Church, who effected a profitable sale of the property. It is now managed by parties who also own controlling interests in Kings River and Fresno Canal Company, and who have acquired the property known as the Laguna de Tache Rancho.

Since the construction of the canal its capacity to divert and distribute water has gradually been increased. It was probably not in excess of 500 cubic feet per second in 1879, at which time approximate gagings were made by the State engineer's department, and the present capacity is about 1,000 cubic feet per second. A test of the canal capacity under the most favorable conditions of flow, but at a time when the branches of the canal were reported to be unprepared to receive the full volume of water, was made in June of this year. The amount of flow was approximated at 1,100 cubic feet per second. During this test the water surface at the gaging station rose 1 inch, showing that the canal had not reached a condition of permanent flow and that the canal and its branches below the station had not been entirely filled with water at the time the gaging commenced. The amount determined by this test must, therefore, be assumed to be in excess of actual capacity. The area now covered by the so-called water rights, issued by the canal company, is about 160,000 acres. The area actually irrigated or benefited by the canal water could not be ascertained with precision, but is thought to be about 70,000 acres.

CENTERVILLE DITCH.

This is at present a branch of the Fresno Canal. It was constructed in 1868 and 1869 by settlers near Centerville (now Kings River). They organized a company known as the Centerville Canal and Irrigation Company, which was incorporated in August, 1868. This company seems to have been the successor in interest to all rights acquired by some of the settlers, whose first steps to secure water were taken in

1865. The canal was constructed southwesterly from a point near where the head of the Kings River and Fresno Canal now is, about 2.5 miles, to Burns Slough. Thence this slough was utilized for about a mile to a point a short distance below the Long Cut, and thence the ditch was extended southwesterly about 3 miles farther to lands at and west of Centerville. The canal property was transferred to the Fresno Canal and Irrigation Company, in 1874, by those who had secured control of the stock, and the opposing minority interests were finally placated by the issuance of perpetual unassessable water rights in the newer canal to stockholders who owned lands near Centerville.

SWEEM DITCH.

This ditch was never completed. Its construction was commenced in 1870 from a point near the present head of the Fresno Canal, practically on the alignment subsequently adopted for that canal. Its purpose was to increase the delivery of water into Burns Slough for the Centerville Ditch. It was sold before completion to the parties who were at work on the Fresno Canal project, and within a few years it was transformed into a large canal, as already explained.

FOWLER SWITCH CANAL.

The head of the Fowler Switch Canal is in Centerville Bottoms, about 100 yards below the head of Fresno Canal. (See fig. 13 A.) Its course is southwesterly for 1.5 miles in Centerville Bottoms, thence westerly for 2 miles across the second bottoms to near the channel of Lone Tree Creek, thence southwesterly 10 miles and southerly 5 miles to a point about midway between Fowler and Selma, thence southwesterly 5 miles, thence northwesterly into the district southward from the Washington Colony. The canal is said to have been built to carry 1,500 cubic feet per second. Its bed width is about 45 feet, its depth variable. The gradient is very irregular, being that of the natural surface of the ground in its upper sections, where quite firm hardpan formation is relied upon to check excessive erosion of the canal bed. Near the lower end of the canal it was given a fall of 1.92 feet to the mile.

It was proposed to use no check weirs to reduce the fall, which for a short distance was as great as 12 feet to the mile, and to put lateral ditches at a lower elevation than the main canal, so as to reduce the necessary structures to a minimum. It was soon found, however, that weirs would be necessary at some points to check erosion and at most points where water was to be diverted.

Among the branches of the Fowler Switch Canal may be mentioned the Cleveland Ditch, about 5 miles long, which delivers water to lands midway between Malaga and Fowler; the Western Canal, which supplies water to lands adjacent to and immediately south of the Sierra Park and Washington Colony; the Grant Ditch, which has a westerly course for 4 to 5 miles from near the end of the main canal; and the Elkhorn Canal, which has a southwesterly course and delivers water to the western portion of the Wildflower region. The entire canal system gave promise of being one of considerable importance to the prosperity of the district it commanded, but hopes have not been fully realized. The canal has not been permitted to take river water without protest, and unfavorable court decisions have thrown some doubt upon the reliability of this canal as a source of supply.

This canal was constructed in 1883. Farmers in the vicinity of Fowler who wanted water for their own lands formed a corporation, the capital stock of which was fixed at $450,000, divided into 1,500 shares, of which 300 were subscribed for. It was agreed that in payment for each share labor and material might be contributed to the extent of $200, the remainder to be paid in coin. It was soon found, however, that the first issue of shares would not cover the cost of canal construction, and it was followed by a second issue of 300 shares, which were taken by the same persons who held the first issue. About $110,000 were expended on canal construction in the first two years.

The water in the canal is apportioned to the stockholders, who may ask for the delivery of their water at any point on the main canal. This has led to the construction of a number of branch ditches under independent management (owned by the landowners), which receive their water from the main canal. One of the principal branches of this sort is the Elkhorn Ditch. It is owned by a company in which thirty shares are represented. Some of the stockholders in the Elkhorn Ditch Company are not holders of Fowler Switch stock. In such cases they are required to buy their water from some stockholder. The use of the Elkhorn Ditch is restricted to its owners, no water being sold.

The water represented by the stock of the Fowler Switch Canal Company is at the disposal of the individual stockholders to the extent that it may be leased or sold and its delivery may be called for through any branch ditch. No system of water measurement or special design of gate has been prescribed. All gates in distributing ditches are constructed by the consumers. The delivery of water through these gates is in charge of a canal superintendent. The canal company itself does not sell any water. All expenses are met by assessing the stockholders.

The structures on the canal do not merit extended notice. They are all of very light construction. The check weirs or drops are A-shaped, upper and lower faces being permanently sheathed with light boarding. There is no diverting dam at the head of the canal, which has been located just above a natural cobblestone and bowlder riffle.

Within the last few years the canal company has adopted the policy of selling water, the charge for the same being 75 cents per acre for each irrigation.

Under the statute which appears to give an appropriator of water the right to change at will the points at which he diverts water, an arrangement has been made by the owners of the Fowler Switch Canal with the Emigrant Irrigation Ditch Company under which the latter is allowed to take a part of the water to which it claims title through the Fowler Switch Canal. The water entering the canal is apportioned to the irrigators entitled to receive water from either of the canals. The area irrigated or benefited by the water of the Fowler Switch Canal, together with that served by the Emigrant Canal, has been estimated at about 10,000 acres. The maximum capacity of the canal is about 700 cubic feet per second.

CENTERVILLE AND KINGSBURG CANAL.

This is another of the important north side canals from Kings River belonging to the upper group of canals. Its head is about 2 miles in a direct line northeast of Centerville, and about the same distance by river below the head of the Fowler

Switch Canal. Its course is westerly for nearly half a mile, directly toward the northwestern margin of Centerville Bottoms. Its second half mile has a southwesterly direction, along the slope from the higher plains to the bottoms; thence on the higher level it holds a course southwesterly and southerly for about 8 miles, practically parallel with the bluff 20 to 30 feet high, which drops from the valley plain to Centerville Bottoms. This portion of the canal is frequently within a few rods of the edge of the bluff, and is rarely more than half a mile distant therefrom.

About 9 miles below its head the canal is separated into a number of branches which radiate throughout the district westward from Kings River below the Narrows, extending southeastward to lands east and south of Sanders, southward to the vicinity of Kingsburg, and southwestward beyond Selma and well into the Wildflower country.

The main canal has irregular dimensions, its bed width being generally about 30 to 35 feet. It has been allowed to cut deep into the friable surface soils in the upper sections of its course, where but little attempt has been made to reduce its gradient below that of the natural surface of the ground. The length of the main canal is about 18 miles. The length of its three principal branches is reported at about 26 miles.

The diversion from the river is effected by means of a brush and cobblestone dam, in which a small gate serves as wasteway and sand sluice. (Fig. 13 B.) The canal regulator is close to the river and is of a type very common on Kings River canals. Three rows of posts rising from a plank floor extend across the canal from one bulkhead wall to the other. They support a platform loaded with cobbles and gravel to give stability to the structure. The spaces between the upper posts are closed by means of vertically sliding gates, each of which has a stem extending above the platform, to which power is applied when the gate is to be opened or closed. The cost of the regulator was about $1,000. The first cost of the canal was about $35,000.

This canal was constructed in 1877 and 1878. It was built by a company organized by farmers who owned lands near Kingsburg and Selma. The capital stock of the corporation which they formed was originally fixed at $12,500, but was subsequently increased to $35,000, being divided into 50 shares. The upper 2 miles of the canal was constructed by day labor. The rest of the main canal was divided into sections, each of which represented one share of stock, and was assigned to some stockholder, who was required to complete it. A few unlimited, unassessable rights to water from the canal have been granted to settlers near Centerville in consideration of rights of way. Each stockholder is entitled to the delivery of a proportional part of the water remaining available for distribution; but each stockholder, or the corporation when in possession of any shares of stock, may lease the shares. The price of a share per month in 1882 was $6. Shares were at that time valued at about $1,500. Each share of stock is supposed to represent "3 feet of water;" an expression of quantity which seems as vague as the amount named in the franchise of the company, "150 cubic feet of water under a 4-inch pressure." In fact, however, each share of stock entitled its holder to a proportional part of the water, varying somewhat according to the number of shares in actual use, but not in excess of three times the amount which would flow 4 inches deep over a clear overfall 12 inches long. Water is apportioned on the judgment of a canal superintendent. When

LEINBERGER CHECK—LOWER KINGS RIVER CANAL

WEIR AT HEAD OF MURPHY SLOUGH FROM BELOW

SCENES ON CANALS

BRANCH OF FRESNO CANAL

ALONG KINGS RIVER

HEADGATE OF LOWER KINGS' RIVER CANAL FROM BELOW

HEADGATE OF LOWER KINGS RIVER CANAL FROM ABOVE

the amount of water per share of stock in the canal exceeds three units, each indicated by a clear overfall of 4 inches on a length of 12 inches, then all surplus water is held for sale, by the directors of the company, at fixed rates per month per unit. The cost of canal management, maintenance, and repairs is assessed upon the stockholders. The annual expense assessment is now about $80 per share of stock. The works required to divert water from the main canal into private ditches, including weirs in the main canal, are constructed by the consumers of water, subject to approval by the canal company.

Satisfactory use of this canal has been interfered with to no little extent by litigation, generally involving the right of the canal to receive water from the river, and, as in the case of other canals from Kings River, its permanent efficiency as a source of supply has been thrown somewhat into doubt by adverse decisions of the courts.

The maximum capacity of this canal is approximately 660 cubic feet per second. The area irrigated or in some way benefited by its water is about 20,000 acres.

ALTA IRRIGATION DISTRICT (76 CANAL).

The canal which supplies water to the Alta Irrigation District is known as the 76 Canal. It belongs to the upper group of Kings River canals. Its head is on the south side of the river about 1.5 miles above the head of the Kings River and Fresno Canal, if the point at which the uppermost work for the direction of water toward the canal regulator may be termed its head. At that point a branch of the river has been enlarged somewhat and otherwise improved, and the water diverted from the main stream through this natural channel is carried in a succession of depressions, or high-water channels, along the southeastern margin of Centerville Bottoms about 3 miles to a point where the canal cuts out upon the higher plain lying to the east of the Centerville Bottoms. The natural depressions or water courses forming the head of the canal have in large part been converted into a canal by building up, along their low western banks, embankments of cobblestones and bowlders, which were taken from the beds of these depressions or water courses in enlarging them. Where the canal turns away from Centerville Bottoms onto the upland a cut 9 feet in depth was necessary. From this point the canal has a general southeasterly course, following a grade line with 18 inches fall to the mile, that skirts the western foothill base. At 6 miles below the regulator the canal is carried across Wahtoke Creek, and its southeasterly course is maintained about 22 miles farther, to near Cottonwood Creek. The main canal has been made the eastern boundary of the Alta Irrigation District.

The bed width of the canal throughout the first 9.5 miles below the regulator is 100 feet. The maximum amount of water carried has been approximated at about 900 cubic feet per second. With a depth of 5 feet of water, which has thus far never been attained, the capacity would be about 1,200 cubic feet per second. From the main canal numerous branches extend southwesterly and southerly into the heart of the district. The principal of these is the Traver branch, which has been given a bed width of 60 feet. It leaves the main canal about 1.5 miles below Wahtoke Creek, and, as its name indicates, delivers water to lands in the vicinity of Traver. Branch canals are for the most part located across the valley plain on lines of its greatest slope. They have generally been given positions on high ground intermediate between gentle depressions, though in some instances, as in the case of the Traver branch, natural water courses have been in large part substituted for expensive canal work.

The inflow of water from the upper canal section into the second section of the main canal is controlled by means of a regulator or headgate. Above the regulator in the west canal bank is a spillway through which surplus waters are dropped into Patterson Slough, one of the Kings River channels in Centerville Bottoms. The regulator is 100 feet wide in the direction across the canal, by 30 feet along its axis. The surface of the floor is at grade of the canal bottom.

The canal was constructed in 1882. This was before the enactment of the irrigation-district law. Its construction was undertaken by a private corporation, on a plan which was very satisfactorily carried out. As soon as the feasibility of making the diversion of water from the river was assured, about 40,000 acres of land on the plains to be commanded by the canal were bought for the corporation at prices less than $10 per acre. These lands were offered for sale as soon as the canal came into service, at prices somewhat in excess of the added cost of canal construction. It was proposed to establish each year a schedule of prices to be adhered to for a year, but the demand for land was so great at the prices fixed during the first few years that the lands were repeatedly withdrawn from sale. The expenditure of less than $300,000 in four years thus created and increased values to an estimated amount of over $800,000, not including increased values of properties in which the canal company had no direct interest.

Before the canal was sold to the Alta Irrigation District water rights were issued to purchasers of all lands sold by the canal company and were for sale to others owning land in the district commanded. A water right was defined as 40 miner's inches of water, and was located upon some particular 40-acre tract of land, of which it became an appurtenance. Each full water right was made liable to an assessment of $20 per year to cover expenses of canal management. The price of a water right was fixed at $200.

The Alta Irrigation District was formed in 1888 and was made to include the lands to be irrigated from the 76 Canal. It extends southerly from Kings River to and even beyond Cottonwood Creek and westerly to within a mile of the eastern border of the Kings River delta, and has an area of 130,000 acres. Two years later the district purchased the canal and its branches, paying therefor $410,000 in bonds of the district. This covered the repayment to holders of water rights of the amounts which they had paid for them.

The northern apex of the Alta Irrigation District is at the western base of Tchoenimne Mountain, where a second river bottom, 10 to 20 feet higher than Centerville Bottoms, lies below the 76 Canal. From the second bottom, which is long and narrow, having an area of nearly 7,000 acres, there is an abrupt rise of 20 to 35 feet to the upland or main east-side San Joaquin Valley plain. The surface of this plain drops away gently from the base of the hills southwestward toward the valley trough. Its slope is at first about 10 feet to the mile, but this becomes gradually less and is only 6 feet to the mile near Traver. The only notable break in the surface of this portion of the valley plain is made by Wahtoke Creek, which, in its southwesterly course from the foothills of the Sierra Nevada, passes to the east and south of Campbells Mountain and discharges into Kings River at the Narrows. It flows in a wide, deep gorge from foothill base to the river. Southward from Wahtoke Creek are several minor creek channels, which carry water only in very wet seasons and sink, or spread before reaching Cross Creek.

After the purchase of the 76 Canal system by the irrigation district in 1890 more branch canals were necessary. These were constructed, under the direction and supervision of the district engineer, by private parties, from whom they were then bought, payment being made with irrigation-district bonds. About 150 miles of branch ditches were thus constructed at a total cost in bonds of $133,000. The entire district is now covered with branch canals, which are rarely more than 2 to 3 miles apart.

The area of land to whose surface water is now actually applied is estimated by the district officers at 50,000 acres. The distribution of water is in charge of a canal superintendent and seven assistants called "ditch tenders."

The soil of this region is for the most part a sandy loam, with coarse, clayey sands near the eastern border of the district, and finer, lighter sands toward the west. Much alkali is in the soil to the west and southwest of Traver. Hardpan subsoils are common at 2 to 5 feet below the surface. Ground water before 1883 was 20 to 50 feet. It was nearest the surface in the southern and western portions of this district. Irrigation is causing the water table to rise, particularly near Traver. It now stands at 2 to 6 feet at Traver and at 5 to 8 feet at Dinuba.

Water is usually available for irrigation from February until the end of July. There is practically no restriction upon the use of water by irrigators. No measurements are made. Each irrigator takes all the water he requires and when he can get it. Where used on a small scale, land is occasionally prepared for it by subdivision into small rectangular checks. This was the preferred system when water was first introduced into the vicinity of Traver. Now the contour-check method of irrigation is finding more favor. The reason for this preference seems to be due not only to reduced first cost, but also to the fact that it requires less cutting down of surface soils than the level-check method of irrigation. The uncovered subsoils are often found to be relatively barren. Orchards, vineyards, and summer crops are quite generally being irrigated by the furrow method. Grain land, if wet at all, is irrigated by spreading water over the surface from small ditches or furrows, usually before sowing, preferably soon after harvest.

This being one of the canals of most recent construction, it is one of those which would be most benefited by a final adjudication of rights. Most of the other canal organizations have been forced to recognize the inexpediency of trusting to legal tribunals to determine relative rights to the use of water on the basis of existing laws and facts which are apt to be more or less distorted. The preferable arrangement seems to be to make agreements with each other, stipulating how the water should be apportioned when there is less than enough for all. Alta Irrigation District being in the most favored position for a diversion of water from the river, and being comparatively a recent claimant, is beset by riparian owners and by other appropriators, and has not only, on complaint of riparian owners, been decreed to have no right to divert any water, except for a very limited amount of riparian land, but in other decisions its rights are made subject to the prior rights of other canals, determined apparently from conditions as they existed when the various causes of action came to trial, rather than upon such conditions as actually prevailed at the time the 76 Canal work was inaugurated in 1882.

The question as to the irrigation district's right to water has not been its only source of trouble. The legality of some of the recent acts of the district directors having been called into question, a decision has been rendered by the superior court, declaring district bonds to have been illegally issued on the ground that plans and an estimate of cost of the work were not made before the bonds were issued.

The annual expense of canal management and water distribution, including litigation, is $14,000 to $18,000. One-third of this amount has in the past been expended for litigation. Twelve thousand dollars is thought to be a reasonable allowance to meet district expenses and to operate the canal system. Money is raised from the property owners of the district to meet current expenses by assessments based on property valuation. Objection to this system seems to be raised only by nonresident property owners. The best lands of the district are, for purposes of this tax, assessed at $25 per acre, and the assessment on lands of this class ordinarily amounts to 20 to 25 cents per acre. To meet interest on outstanding bonds this tax rate is doubled.

SELMA IRRIGATION DISTRICT.

Selma Irrigation District was organized in 1890 for the purpose of securing better control and more satisfactory distribution of water throughout the territory commanded by the Fowler Switch and the Centerville and Kingsburg canals. The district lay upon the north side of Kings River, extending southwesterly from Sanger. It had an area of 271,000 acres. It was proposed to issue bonds to the amount of $1,000,000 for the purchase of existing canals and the improvement of distributing works. The bond issue was, however, twice defeated at the polls and all proceedings under the district organization have been abandoned. The existence of the district has been legally terminated.

SUNSET IRRIGATION DISTRICT.

Sunset Irrigation District covered the lowest portion of the west-side plain of San Joaquin Valley, extending northward from the southern limit of Tulare Lake 70 miles to within 3 miles of the point where Fresno Slough unites with San Joaquin River. Its width ranged from 1 to 12 miles, and its area was about 363,500 acres. The district organization was effected in March, 1891. Water for the district was to be obtained by gravity flow from the vicinity of Summit Lake, where a large area in the delta region of Kings River was to have been converted into a reservoir. Those portions of the district which could not be covered by gravity flow from this source were to be served with water pumped by means of centrifugal pumps to higher lying canals. For the terms of the contract made by this district with the owners of Laguna de Tache Rancho reference may be made to the paragraph relating to the canals of this rancho (p. 308). The district voted a bond issue of $2,000,000; of this amount $25,000 was paid for water rights, a reservoir site, and rights of way. Although the directors entered into a contract for the construction of the necessary irrigation works at an agreed price of $1,500,000 no works were constructed. As a result of litigation the district has been declared illegally organized, and all district proceedings have been terminated.

CARMELITA DITCH.

This is a small ditch which supplies water to the lands of the Carmelita Vineyard Company and to Mrs. M. J. D. Reese. Its head is near and just below the wastegate of the 76 Canal. The ditch was built in 1896 to divert the water claimed under a notice of appropriation filed by S. F. Earle. The amount claimed is 5 cubic feet per second. The ditch has a direct connection with a channel of the river and can also be supplied with water from the 76 Canal. During the greater part of the year water is delivered into the ditch from the 76 Canal, but in August, September, and October, when there is no water in the canal, it is let into the ditch through an 8-foot headgate direct from the river. The right to use water is claimed as a riparian right.

The cost of the ditch was about $400, and the annual expense for maintenance is about $25. Litigation with the Peoples Ditch Company, the Lower Kings River Water Ditch Company, the Last Chance Water Ditch Company, and with owners of ditches in the Centerville Bottoms has cost about $300, and the various actions have not yet been brought to trial. The method of irrigation with water from this ditch is chiefly by saturation of subsoils, it being deemed advisable to keep ground water within 8 feet below the surface.

PEOPLES DITCH.

This is a canal of the lower group whose head is on the south side of Kings River, about one-half mile above the head of Cole Slough. Kings River at this point flows in a broad, sandy bed, to which there is a steep descent of about 15 feet from the level of the main valley plain on the south. The canal follows the margin of this plain for some distance southwesterly as it recedes from the river, and is gradually brought out upon the surface of the plain about 3 miles below its head. At about 4 miles below its head the distribution of its water to its branches commences. The diversion of water from the river is effected at low stage by means of a dam of brush and sand, which is annually repaired at considerable expense. Until within the last few years the inflow into the canal was controlled by two regulators, one of which was within a quarter of a mile of the river bank, the other about 2 miles below. These were 24 feet in width and were of the ordinary culvert type with vertically sliding gates.

There is a new regulating gate now in service within several hundred yards of the head of the canal. (Fig. 14 A.) This is a massive, well-built structure, 38 feet wide between side walls, which supports an earth fill about 2 feet thick, serving as a roadway over the canal. The space between side walls is subdivided by 10-by-10-inch posts into ten bays or openings, each of which is closed by means of a vertically sliding gate. Power is applied to the gate stems by means of a lever, the end of which engages between the teeth of a rack.

The canal has a fall of only about one-half foot in the first 2 miles of its course. The effective fall is increased somewhat by keeping the brush dam at a good height. The canal as originally constructed was 24 feet wide on the bottom, and was intended to carry 4 feet of water. Its estimated capacity was about 220 cubic feet per second. As approximated this season the capacity may be noted at 330 cubic feet per second. Below the second regulating gate the width of the canal increases to 30 feet, and the depth of water to be carried is only 3 feet. These dimensions are maintained for about 4 miles, still in a southwesterly direction and extending well into the northeastern extremity of that portion of the Kings River delta usually referred to as the Mussel Slough country. The canal has three principal branches—West Fork, which terminates near Grangeville; Middle Fork, which passes just to the

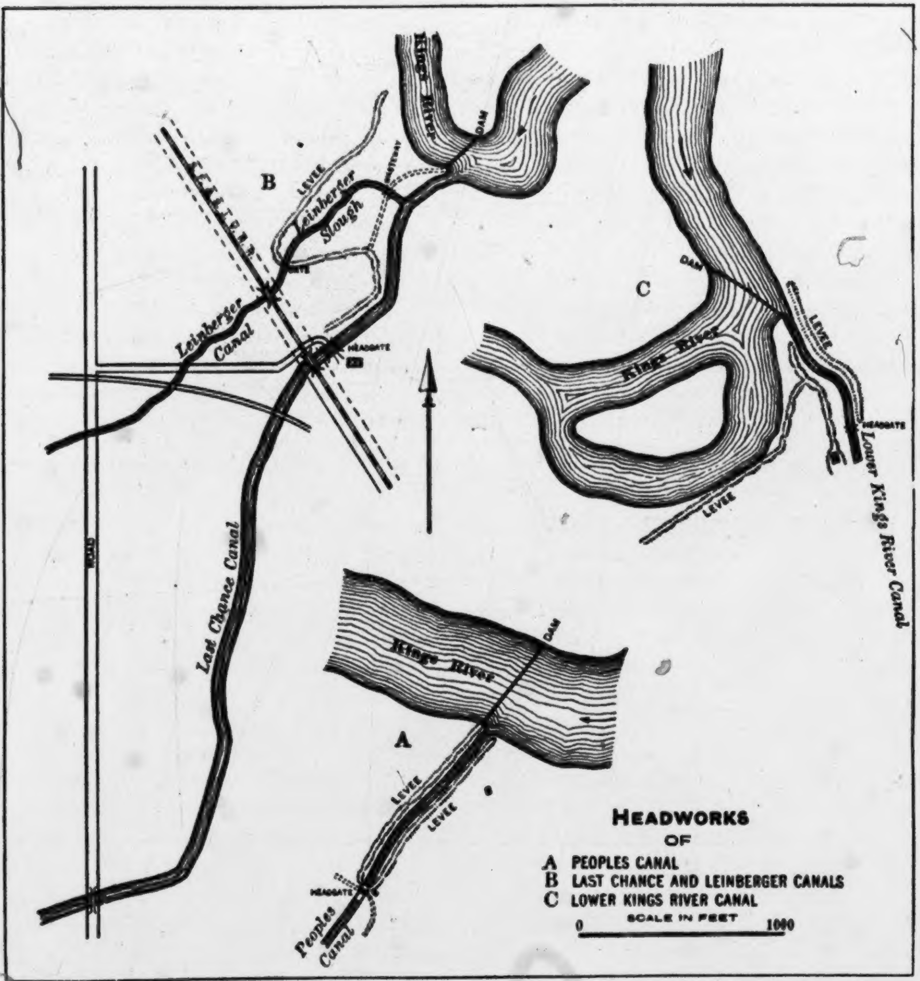

Kings River
DAM
B
LEVEE
Leinberger Slough
WASTEWAY
GATE
Leinberger Canal
HEADGATE
ROAD
Last Chance Canal
C
DAM
Kings River
LEVEE
HEADGATE
LEVEE
Lower Kings River Canal
Kings River
DAM
A
LEVEE
LEVEE
HEADGATE
Peoples Canal
HEADWORKS
OF
A PEOPLES CANAL
B LAST CHANCE AND LEINBERGER CANALS
C LOWER KINGS RIVER CANAL
0 SCALE IN FEET 1000

FIG. 14.—A, headworks of Peoples Canal; B, headworks of Last Chance and Leinberger canals; C, headworks of Lower Kings River Canal.

westward of Hanford; and East Fork, which passes through the southern portion of Hanford, and extends to points 4 miles farther south. The aggregate length of the main canal and its principal branches is about 37 miles. This canal was constructed by the Peoples Ditch Company in 1873 and the following years. The first notice of a claim to water was posted late in 1872. The company, formed by settlers who wanted water for their own lands, was finally incorporated in 1873. Its capital stock, originally fixed at $10,000, was soon increased to $35,000, and later to $100,000. The first cost of the canal was about $50,000 to $60,000. The total cost of canal construction and annual expense accounts had reached $120,000 in 1881. About $4,000 to $6,000 is annually expended on the dam. The total annual expenditure for management, maintenance, and repairs is about $10,000.

Of the 100 shares into which the company's capital stock is divided about one-third have reverted to the corporation. The remaining shares are in the hands of irrigators, to whom water is delivered in amounts proportional to their holdings of stock. The stockholders are permitted to sell the water to which they are entitled, and to ask for its delivery through any of the canal branches. Its use is not restricted, except for the season, to any particular tract of land. The delivery of water to irrigators is usually through gates 1 to 4 feet wide. It is discharged under pressure, the endeavor being to make amounts delivered proportional to stock which it represents without any attempt at actual measurement. A canal superintendent, with necessary assistants, has charge of the delivery of water. Its equitable distribution depends largely on the judgment of the canal superintendent.

During the years 1883 and 1884 the experiment was tried of selling water to stockholders at $200 per share of stock per year; to those not holding stock an equivalent quantity at $300 per year, but it did not prove satisfactory. All stockholders are assessed to meet the annual expenses. The area of land actually irrigated or benefited by the water of this canal is about 25,000 acres.

MUSSEL SLOUGH DITCH.

This canal, which is now out of service, took its name from one of the delta channels of Kings River, which has been utilized for the distribution of water. The canal, unlike the other canals of the Kings River delta, was constructed for speculative purposes. It was proposed to turn a large volume of water from the river into the slough and to derive a revenue from its sale to irrigators. The head of the canal was on the south side of Kings River, about 7 miles below the head of the Peoples Ditch. A narrow cut, the original bed width of which was about 10 feet, was made from that point southerly and thence southwesterly along the upper portion of the channel of Mussel Slough. The bottom of this cut throughout a little more than a mile from its head was made level, being at an elevation a little below that of the river bed at the head of the canal. The upper portion of this cut, near the river, is over 14 feet in depth. As the canal leaves the river it grows wider, and at about 3 miles from its head the natural channel of Mussel Slough afforded ample capacity for its waters.

Mussel Slough and its principal branches, Sand Slough and Lone Oak Slough, have a general southwesterly course through the delta lands, passing to the west of Hanford and extending to the high-water line of Tulare Lake. The canal is now out of service and was not in use for three years preceding 1896. Its head was closed with an embankment of earth in 1894, because at that time the river threatened to destroy the canal headgate and cause inundation of the upper and central portions of the delta.

The canal headgate or regulator was placed in the deepest portion of the cut, near the bank of the river. It was made 24 feet wide, the space between its walls being divided into a number of openings by vertical posts, between which gates slid vertically. The structure had the usual upper platform loaded with earth, making a roadway 20 feet wide. Its floor length was 40 feet. Sheet piling 8 feet deep was used on the upper floor line and for 12 feet under each wing; sheet piling was also driven 6 feet deep across the canal, on the middle line of the floor, and at its lower edge.

Throughout the length of the natural channel utilized for the water of the Mussel Slough Ditch, check weirs or gates were constructed with which to hold the water surface at or above the surface of the ground. Irrigation was to be accomplished by subirrigation on a large scale. The charge for water ranged from 31.25 to 62.5 cents per acre per year. There was little or no restriction as to the amount of water to be used by individual takers of water, and the principal duty of the canal superintendent seems to have been to prevent those from taking water who had no intention of paying for it. The total cost of the canal works connected therewith was about $50,000 to $60,000.

This canal was constructed in 1875. Its promoters formed a corporation with a capital stock fixed at $500,000, divided into 10,000 shares, all of which remained in the hands of a few persons. The canal capacity was about 200 to 300 cubic feet per second.

LAST CHANCE DITCH.

One of the most important of the Kings River delta canals is the Last Chance Ditch, whose head is on the south side of the river about 2.5 miles by river above Kingston. The course of the canal and its branches is southerly. It commands a district 3 to 4 miles wide, extending from near the river southerly to near high-water line of Tulare Lake. Grangeville lies at the eastern border of this district and Armona well within it. Lands along its eastern border are commanded jointly by this canal and the Peoples Ditch. A natural cut through the south bank of the river, known as Leinberger Slough, has been utilized for the head of the canal. (Fig. 14 B.) This slough is really one of the lower delta channels of the river. The canal is cut from its south bank, about 150 feet from the river. The canal regulator is about 800 feet below its head. The water entering the head of the slough is divided, a portion flowing down the natural channel, the rest entering the head of the Last Chance Ditch. The canal has a bed width of 25 feet, and was designed for a 4-foot depth of water. Its course is a little west of south for 7 miles to a point half a mile west of Grangeville, where it is divided into two principal branches. One of these has a southwesterly course, and at the end of 3 miles drops its water into a natural channel which has a southerly course and connected with Mussel Slough. The other branch is again divided within a mile, forming a middle and an eastern branch, both of which extend far toward the south. These main branches were all made 16 feet wide on the bottom, and were planned to carry water 2.5 feet deep. The gradient of the canal is about 1 foot to the mile.

The original canal regulator, which was in service from 1874 to 1880, was made 18 feet wide between side walls and is reported to have cost $5,600. It was replaced by a second one, 20 feet wide, at a cost of $3,000. The removal of sand from the canals, which had been swept in by high water during the period when there was no gate at the head of the canal, is said to have cost $3,000. The regulator now in use is of the ordinary box type. Its side walls rise to a height of 14 feet. Between them are posts which support a platform or bridge that affords convenient access to the gates. The gateposts divide the space between the side walls into six openings, each of which is closed with planking permanently from the top down to about 5 feet from the floor.

The Last Chance Ditch was constructed in 1873 and 1874 by a company known as the Last Chance Water Ditch Company, which was organized and incorporated by the farmers to whose land it was to supply water. The original 30 shares into which the capital stock of $30,000 was divided were a few years later increased to 60 shares, and the capital stock was also doubled. Only about two-thirds of these shares are in the hands of stockholders. Until 1886 all operating and repair expenses, about $4,000 per year, were assessed upon the stockholders, and water was delivered to these without charge, in proportion to the amount of stock owned or controlled. Very little water is sold by the acre.

There has been no system of water measurement introduced. Water is delivered to irrigators through a great variety of gates; generally, however, through openings under pressure. A canal superintendent and an assistant have charge of its distribution. During the high-water period an attendant is kept constantly at the headgate. The canal ordinarily carries water from the beginning of February to the end of July.

The cost of canal management and maintenance during the last three years has been about $8,000 per year. One-half of this amount was expended for litigation. The operating expenses ordinarily are about $4,000 per year. The canal this year was found to be quite foul with weeds and much land in the district commanded by the canal seems to have been injured by too copious subirrigation, with a resulting accumulation of alkaline salts in surface soils. The area irrigated by the canal and that benefited to a greater or less degree by its waters is about 20,000 acres. The canal capacity has been approximated at 360 cubic feet per second.

LEINBERGER SLOUGH.

This is a natural high-water channel and receives water from Kings River on its south side at the same point as the Last Chance Ditch. When the Last Chance Ditch was constructed, advantage was taken of the upper end of this natural water course and water was diverted through it into the artificial canal. It is only within the last few years that systematic effort seems to have been made to utilize the water of the slough, although a headgate has been maintained in it for a much longer period just below the point at which the Last Chance Ditch leaves it. Its capacity may be noted at about 50 cubic feet per second. After flowing about 4 miles in the natural channel of the slough, the water is turned into a canal having a southerly direction and used for the purpose of supplying water to the lands of the owners of the ditch. This distribution of water from the ditch is under control of a superintendent, and water is apportioned according to the needs and relative interests of the owners.

LOWER KINGS RIVER CANAL.

This is another south side canal in the Kings River delta. Its head is about 6 miles below Kingston. (Fig. 14 C.) Its course is southerly, and the district it commands lies just westward of that of Last Chance Ditch and has Lemoore in its center. The canal is cut southerly from the river, and at the end of its first mile reaches Leinberger Slough, into which its water is dropped. (Fig. 15 A.) It is reclaimed from this slough less than half a mile below that point, and thence has a southerly course to within about 3 miles of Lemoore. Two principal branches—the East Branch, about 40

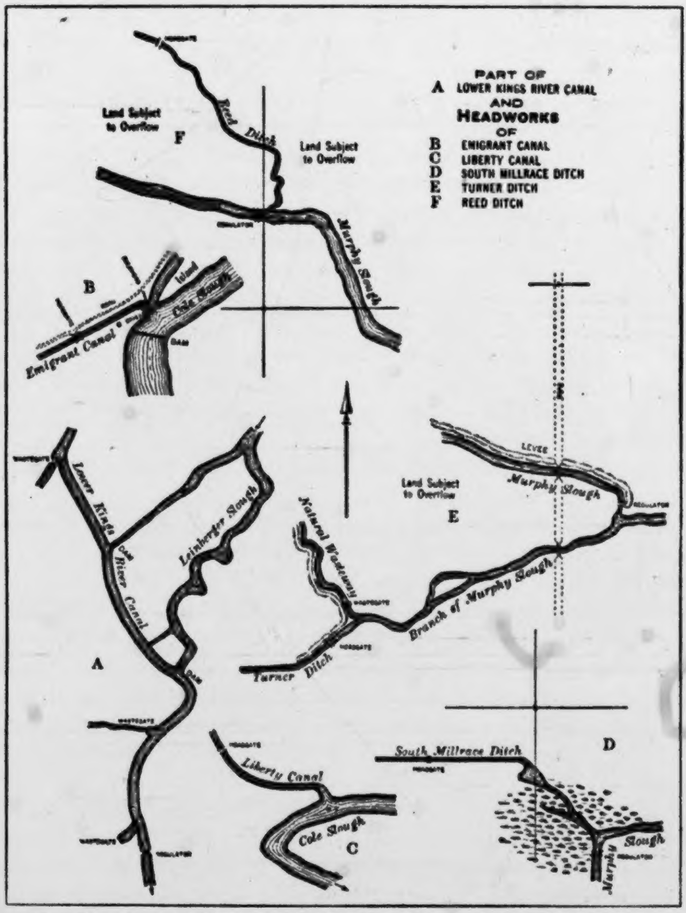

PART OF
A LOWER KINGS RIVER CANAL
AND
HEADWORKS
OF
B EMIGRANT CANAL
C LIBERTY CANAL
D SOUTH MILLRACE DITCH
E TURNER DITCH
F REED DITCH
Land Subject to Overflow
F
Reed Ditch
Land Subject to Overflow
Murphy Slough
B
Island
Cole Slough
Emigrant Canal
DAM
Lower Kings River Canal
Leinberger Slough
DAM
A
Natural Waterway
Land Subject to Overflow
E
LEVEE
Murphy Slough
Branch of Murphy Slough
Turner Ditch
Liberty Canal
Cole Slough
C
South Millrace Ditch
D
Slough
Murphy

FIG. 15.—A, Lower Kings River Canal; B, headworks of Emigrant Canal; C, headworks of Liberty Canal; D, headworks of South Millrace Ditch; E, headworks of Turner Ditch; F, headworks of Reed Ditch.

feet wide, and the West Branch, about 16 feet wide—extend toward the south from this point. Near the river the main canal crosses high-water sloughs fed by the overbank flow from Kings River. These natural channels have been closed by dams on the lower or west side of the canal. Their water, together with other water escaping from Kings River above the head of this canal, is received by the canal and carried to Leinberger Slough. At the point where the canal leaves this slough a wasteway 50 feet long is maintained, through which surplus waters are discharged. This is a very light structure, which is reported to have rendered good service. Its length was recently reduced from 260 feet to 50 feet. Some years ago it was proposed to supplement it with a second wastegate 200 feet long, nearer the head of the canal. The main canal regulator or headgate has been set close to the river bank. A secondary regulating gate is just below the Leinberger Slough wastegate. Each gate is about 42 feet wide between side walls. The headgate is arranged similarly to that described for the Last Chance Ditch. The main canal is about 40 feet wide. It was built on a very light grade. The bottom of the canal, commencing at the same elevation as the river bottom, was reported level throughout the first 5 miles of its course. The effective gradient (slope of water surface) when full is reported at 5 inches to the mile, with a 2.5-foot depth at the forks of the canal. Work on this canal commenced in 1870. The entire delta region of the river was naturally well watered, but the water was irregularly and unequally distributed; to become really beneficial it had to be brought under control. This canal was the first enterprise of magnitude with this end in view constructed in the delta region of the river. Twenty-seven persons, all interested landowners, joined in an agreement under which the canal was to be constructed, and which provided that each person was to bear a proportional part of "all expenses above" his "farther boundary." It was at first made 18 feet wide on the bottom near its head, and 10 feet wide at 5 miles below its head. It was enlarged in 1873. The first headgate was constructed in 1872 and is reported to have had a width of 18 feet. It was washed out the following winter and was at once replaced by another, which was in use till 1876. After this second regulating gate was swept away the canal was operated without an upper gate until 1877, when the third regulator, 40 feet wide, was built, at a cost of about $3,000. The fourth gate, built in 1881, is now in service.

The canal was built and is owned by those to whom it supplies water. Its owners, who had organized as a company, formed a corporation in 1873 with a capital stock fixed at $30,000 in 100 shares.

The water in the canal is supposed to be represented by those shares of stock which have been issued, which is a little more than one-half of the full number of shares of capital stock. It is sold by directors of the company, but only to the extent of the shares which have been issued. Each of these represents a proportional part of the flow of the canal until such part exceeds 144 miner's inches. Water in excess of this amount is at the further disposal of the company. Stockholders are preferred purchasers of water to the extent of the shares owned by each, and provided the application for water is made preceding a fixed date. Each share of stock is supposed to represent sufficient water for 320 acres. The annual cost of canal management and repairs is from $3,000 to $4,000. The first cost of the canal was about $30,000. For a number of years after organization all expenses were assessed upon stockholders, but this proving unsatisfactory the plan of selling water was introduced with good results. The extent of irrigation from this canal may be noted at about 20,000 acres. The capacity of the canal may be noted at about 245 cubic feet per second.

RHOADS CANAL.

This was originally an independent canal, supplying about 3,000 to 4,000 acres of land westward of Lemoore. The canal received water from a high-water slough upon the south side of the main channel of Kings River, and the canal itself, in its upper section, had the appearance of a natural high-water channel. The upper section of the canal was originally known as Wrights Cut, and was claimed to be an enlargement of a small ditch constructed when irrigation in this district was in its infancy. The canal now has no separate headgate, but receives water from the Lower Kings River Canal.

TULARE LAKE BED CANALS.

During the last three years, owing to a recession of the waters of Tulare Lake, farming operations have been gradually extended over the area before covered with water. The lands, after the recession of waters, are as much in need of irrigation as the higher plain-lands. Owing to the very flat and smooth surface of these lands ditches are very readily and quickly constructed. In this way a number of canals for the distribution of Kings River water have been constructed on the east and west sides of the main channel of the river. Three thousand to 4,000 acres of land are thus served with water at the highest stages of the river.

KINGS CANAL.

This canal was recently constructed by the Kings Canal and Irrigation Company. It receives water from one of the high-water channels of Kings River at the northern margin of the lake bed, has an easterly course for about 5 miles, and sends several branches in a southerly direction from 1 to 2 miles into the area once covered by lake water. The canal has a bed width of about 60 feet and the principal laterals have been made 30 feet wide.

WEST SIDE CANAL.

This canal takes water from Kings River several miles north of the old lake margin, has a southwesterly course for 5 to 6 miles, and irrigates lands along the western margin of the lake bed. This canal is about 40 feet wide.

CLAUSEN & BLAKELEY CANAL.

Another west side canal receiving water from Kings River about a quarter of a mile below the head of the West Side Canal is the Clausen & Blakeley Canal. It has a southwesterly course and is about 3 miles long. Its width is about 60 feet.

LOVELACE CANAL.

This canal is located in the northern portion of the lake bed near the point where the waters of Kings River separate. It has a westerly course and a length of about 1.5 miles.

The value of the Tulare Lake lands and the importance of the canals for their irrigation remains to be demonstrated.

EMIGRANT DITCH.

This canal was a few years ago classed as being almost out of service. It is the uppermost of the north side Kings River Canals of the lower group. It originally took water from the north side of Cole Slough, about 2 miles below the head of that arm of Kings River, and still receives a portion of the water to which it is entitled from this source. (Fig. 15 B.) Its course is southwesterly, nearly parallel with Cole Slough, for about 3 miles, thence northwesterly to and beyond Wildflower. The canal was constructed by an organization of farmers who wanted water for their lands, and was to be managed for mutual benefit. The interested parties formed a corporation late in 1875, with a capital stock of $20,000, in shares of $1,000 each. The canal company soon became involved in disastrous litigation, and for a number of years it appeared as though it would be denied the right to maintain headworks at Cole Slough. An arrangement was made by the canal company with the owners of the Fowler Switch Canal under which the main canal and distributaries of the Emigrant Ditch Company were made to receive and distribute Fowler Switch water. When an injunction was issued by the courts against the Fowler Switch Company, restraining it from taking water from Kings River, a portion of the water right of the Emigrant Ditch Company was floated to the head of the Fowler Switch Canal. The water taken through the Fowler Switch Canal, together with that entering the original head of Emigrant Ditch, is distributed to the stockholders. Each stockholder of the Emigrant Ditch Company is entitled to the use of canal water in proportion to amount of stock owned. He is allowed to sell or rent his water at pleasure. Each consumer of water is required to build his own delivery gate, subject to the approval of the directors. The distribution of water is in charge of a canal superintendent, which office is annually let to the lowest bidder. The canal has a bed width of about 16 feet, and delivers its water to a number of branches, which cover about 7,000 acres. The capacity of the Emigrant Ditch is about 155 cubic feet per second.

LIBERTY CANAL.

This is a canal which was constructed about 1882 from the north side of Murphy Slough, its head being about 5 miles above Riverdale. After experiencing much trouble in obtaining a satisfactory supply of water from Murphy Slough, which is the extension of Cole Slough, the original head of the canal was abandoned several years ago, and the canal was extended easterly about 7 miles to a connection with a high-water escape way from Cole Slough, known as the Sutherland Canal. The inflow into the canal is controlled by a regulator placed in the Sutherland Canal about one-eighth of a mile from Cole Slough. (Fig. 15 C.) The canal is about 15 miles long, has a westerly course for 7 miles and thence a northwesterly course, is about 20 feet wide, and its branches cover about 5,000 acres to the north of Riverdale. The amount of water received by this canal is controlled by the owners of the Laguna de Tache Rancho. Irrigators from it have never felt sure of receiving the necessary amount of water, yet have at times received enough, or rather applied enough to portions of their lands to permanently injure considerable areas. The rising of the water table and the consequent wetting up of the surface soils with moisture from below, has brought alkali in undesirable quantities to the surface, ruining many acres of land and sometimes proving destructive even to such cultures as vineyards and orchards.

MURPHY SLOUGH ASSOCIATION.

To avoid protracted litigation between the appropriators of water from Cole and Murphy sloughs (water being required from these sloughs for the irrigation of lands to the north and westward of the Laguna de Tache Rancho) an association was formed, which was substantially in the nature of an agreement for the apportionment of the waters of Murphy Slough. Murphy Slough is practically a westerly extension of Cole Slough. The Murphy Slough Association was formed in 1899, and its organization was participated in by the owners of the Laguna de Tache Rancho and by the owners of the Turner, the Millrace, the Reed, the Riverdale, and Burrell ditches. According to this agreement the water of Murphy Slough, until the same exceeds 300 cubic feet per second, is divided into two equal parts, one-half going to the rancho, the other half to be divided between the several ditches as follows: The Turner Ditch takes one-sixth, the Millrace one-third, the Reed one-sixth, and the Riverdale and Burrell ditches one-third. The Murphy Slough Association has been incorporated, and the agreement as to the apportionment of water is to remain in force five years. This agreement has to the present time been quite satisfactory, and the general opinion prevails that at the expiration of the time named it will be renewed. A superintendent is appointed by the association, whose duty it is to attend to the proper apportionment of the waters of the slough.

MILLRACE CANAL.

The Millrace Canal was constructed in 1882. It really consists of two independent canals, one upon the north side of Murphy Slough, the other between two branches thereof, both controlled by the same corporation. (Fig. 15 D.) The south ditch was built a short time before the north ditch. The capacity of the south Millrace is about 15 cubic feet per second, and that of the north Millrace is about 60 cubic feet per second. The north Millrace has a northwesterly course and a length of about 12 miles. It is in part a natural channel, and has a number of branches extending westerly into the Fresno Swamp region.

TURNER DITCH.

This ditch was built in 1875 to carry 60 cubic feet of water per second. It is reported to have been enlarged in 1890 to carry 90 cubic feet per second. Its present capacity is about 50 to 60 cubic feet per second. It is one of the ditches receiving water from Murphy Slough, under control of the Murphy Slough Association, and irrigates lands on the eastern margin of Fresno Swamp, westward from the Laguna de Tache Rancho. (Fig. 15 E.)

REED DITCH.

This is one of the old ditches supplied with water by Kings River. Its head is on the north side of Murphy Slough, about 4 miles below Riverdale. (Fig. 15 F.) It was originally a small private ditch, having a bed width of about 5 feet and a length of about 4 miles, irrigating a few acres of land near Elkhorn. It was enlarged in 1891, and its owners formed a corporation. Its present capacity is estimated at about 30 cubic feet per second. The lands it irrigates lie along the eastern margin of Fresno Swamp.

RIVERDALE DITCH.

The Riverdale Ditch was built in 1875 and is owned by a corporation. It receives water from the south channel of Murphy Slough through a headgate used in common with the Burrell Ditch. (Fig. 16 A.) Its capacity is about 15 cubic feet per second, its bed width being only about 10 feet. It serves a small area in the vicinity of Riverdale with water.

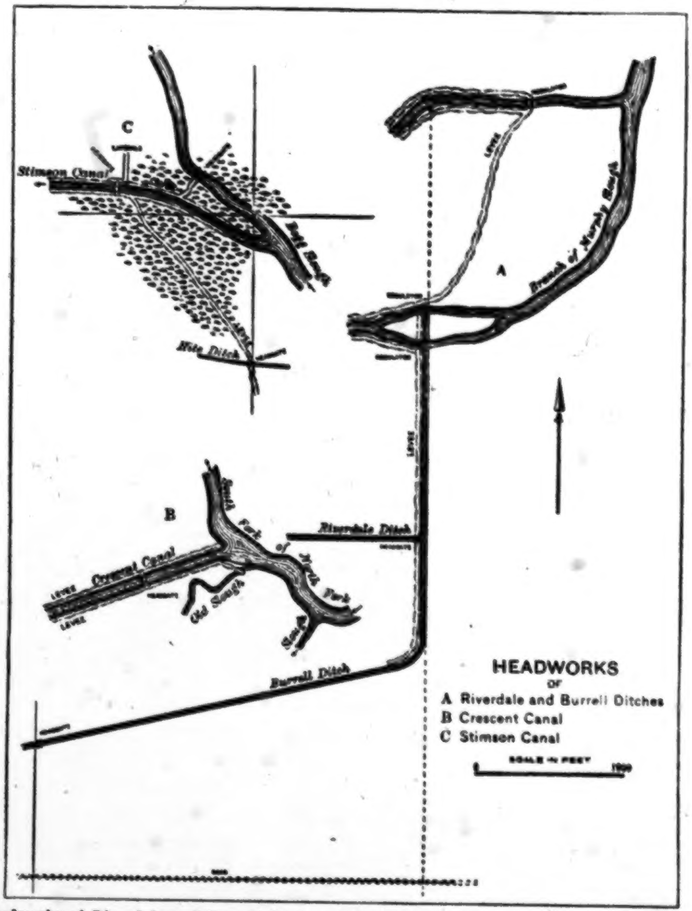

C
Stimson Canal
Hite Ditch
A
Levee
Branch of Murphy Slough
B
South Fork of Kings River
Riverdale Ditch
Crescent Canal
Levee
Old Slough
Burrell Ditch
HEADWORKS
OF
A Riverdale and Burrell Ditches
B Crescent Canal
C Stimson Canal
SCALE IN FEET
0
1200

Fig. 16.—A, headworks of Riverdale and Burrell ditches; B, headworks of Crescent Canal; C, headworks of Stimson Canal.

BURRELL DITCH.

This ditch has a common head with the Riverdale Ditch. (Fig. 16 B.) It was constructed in 1890, and has a capacity of about 65 cubic feet per second. It receives water from Murphy Slough, under control of the Murphy Slough Association.

ROUNDTREE DITCH.

Just below the Reed Ditch, also upon the north side of Murphy Slough, is a small ditch known as the Roundtree Ditch. It was constructed in 1889. It is a high-water ditch, generally receiving water about once a year for a short time, and irrigates a small area of grass land. Its width is 10 feet, and its capacity about 20 cubic feet per second. It is reported that the ditch is to become a branch or lateral of the Reed Ditch, as its owner is one of the stockholders in the latter. This ditch has not joined the Murphy Slough Association, its owner being in doubt as to the effect which this step might have upon his water rights.

LAGUNA DE TACHE RANCHO CANALS.

The Laguna de Tache Rancho is sometimes also referred to as the "River Ranch." The lands combined under one ownership in the River Ranch have an area of about 68,000 acres. It embraces within its boundaries nearly all of the delta lands of Kings River northward from the main stream. A main canal has been constructed for the irrigation of the greater part of this ranch, and is known as the Laguna de Tache Canal or the Grant Canal. A large portion of this ranch is annually submerged during the high stages of Kings River. The area subject to such flooding has, however, been considerably reduced by the construction of a north-side river levee along a portion of the ranch frontage. There are a number of north-side delta channels which break out from the main stream within this ranch, most of which have westerly courses toward the valley trough. The history of these, as related by local residents, is not without interest. The present head of Cole Slough is a waterway made by the freshets of 1861–62. It was enlarged and deepened by subsequent high waters. Cole Slough is the principal north-side delta channel. Its waters are carried westward by the several branches of Murphy Slough, and finally reach the upper portion of Fresno Swamp, through which they are carried in a network of channels, as frequently found in tule swamps, to Fresno Slough and San Joaquin River, many miles northwestward. Before 1862 Cole Slough received water from the river through a channel known as the Arroyo de Hotansas, the head of which was about a quarter of a mile below the present head of the slough. This channel was about 3 miles long. Until 1869 Cole Slough occupied a channel which at a point about 3 miles in a direct line above Kingston was less than a quarter of a mile from Kings River, but in that year Mr. St. John, one of the owners of the ranch, made a small ditch westward from the north slough bank about 6 miles below its head. This ditch was enlarged by the next high water; it lost the appearance of a ditch, and is now called St. Johns Channel or New Cole Slough. It reunites 3 miles below its head with the original slough channel at a point also known as the head of Murphy Slough.

A small ditch, constructed in 1868 by a settler known as Dutch John, connecting Kings River with Cole Slough at the point where the two channels were nearest together had meanwhile also been converted into a capacious water course, and has since been known as the Dutch John Cut. In the same winter, 1868–69, the river broke through the barrier separating it from Murphy Slough at a point about 3 miles (by river) below the Dutch John Cut and formed Reynolds Slough, which is about one-half mile long.

The main Grant Canal was constructed in 1873. Water was diverted for it from Murphy Slough, near Reynolds Slough, which latter was permanently closed by means of a dam. Two years later, by permission of the owners of the Grant, a new connection between Cole Slough, half a mile above the head of Grant Canal, and Murphy Slough, nearly the same distance below the canal, was made by settlers who were desirous of increasing the flow of water in the channels reaching the vicinity of Elkhorn. Its projectors subsequently filed a claim to water and incorporated under the name of the Vanderbilt Canal Company. Settlers in the vicinity of Riverdale and Elkhorn claim that the original cut was entirely artificial, while owners of the Grant claim that the cut is merely the result of cleaning out the head of a natural water course. After the Vanderbilt Cut had become one of the channels for Cole Slough water, the Grant Canal was extended upstream across Murphy Slough to the Vanderbilt Cut, from which it has ever since taken its water. The turning of the flow of Cole Slough into the Vanderbilt Cut is accomplished by means of a dam of earth across the old south channel. From the cut water is turned into the head of the canal by means of a second earth dam, and, flowing in the canal, it crosses Murphy Slough between two dams, of which the lower or westerly one is an overfall dam of brush work, serving as a waste for surplus waters and feeding the lower sections of Murphy Slough.

The Laguna de Tache Canal has a westerly course along the northern bank of the main channel of Kings River, from which it is generally less than one-half mile distant. At 5½ miles below its head it crosses a water course known as the James Canal on an earthen dam, and its direction becomes southerly. It reaches the river bank within a mile and closely follows it southerly for about a mile farther, crossing and closing the head of another delta channel of Kings River known as Old North Fork. The upper section of the main canal for a distance of about 4 miles from its head has a bed width of about 30 feet and carries water 2 to 2.5 feet deep. The distributaries from the main canal are for the most part natural channels, many of which have long ago ceased to serve as delta channels and are mere swales on tops of low ridges.

The James Canal is a channel of more recent formation, which has been utilized as a distributing ditch. By permission of the owners of the grant, a gate for the control of its flow was put into this channel in 1880. It was washed out by the next freshet and was replaced in 1881, but was again destroyed. Thereupon the owners of the grant permanently closed this channel with the embankment of earth on which the canal is carried across. The head of Old North Fork, which is another distributary of canal water, was closed as early as 1865 by Messrs. Sutherland & Mann.

One of the most important of the lower river north-side delta channels is the Zalda Canal, which, throughout its lower sections is generally known as the North Fork of Kings River. It is claimed that the head of this channel is the enlargement by flood waters of a ditch constructed in 1872 by settlers living to the west of the grant. This channel was reported closed for a time by a dam at the river about 1885. It was at that time proposed to utilize this channel as one of the distributaries of water from the Grant Canal. The course of North Fork is westward in a very direct line toward Summit Lake, but before the lake is reached its main channel swerves northward into Fresno Swamp. The portion of the Kings River delta between the main river on the south and the Zalda Canal on the north marks the very flat summit between Tulare Lake and Fresno Swamp. In the trough of the valley, near and to the south of Summit Lake, the general elevation of the ground's surface on this summit, the lowest point on the border of Tulare Lake, is about 214 feet above mean sea level. During the last high stage of the lake, in 1868, the depth of water over the general surface of the country at this point was about 6 feet.

The lands of the Laguna de Tache Rancho have always been so well watered that the irrigation works which have been constructed may be regarded as serving primarily to establish a convenient control of the water rather than as works intended to increase the supply. To prevent excessive natural inundation it has been found necessary to erect embankments along the river; also to construct numerous drain ditches from low tracts into natural channels to facilitate drainage. The main irrigation canal supplies water to a large number of distributaries, frequently natural channels, and these in turn to small irrigating ditches, usually 200 to 450 yards apart. As the entire irrigation system lies within the limits of the rancho, there has been less study of methods of controlling and distributing water than would have been the case if a large number of consumers had to be supplied, and water measurement has been entirely out of the question.

The Laguna de Tache Rancho has within the last few years become the property of the same parties who control the Fresno Canal. The future of both properties was kept in mind when the owners of the Grant sold Kings River water to the Sunset Irrigation District, to be diverted, by way of Cole Slough into the enlarged Grant Canal, thence across the Zalda Canal (North Fork) to a proposed reservoir near Summit Lake. According to the terms of this agreement the district is given a right of way and a reservoir site, and water is sold to it to the extent of 3,500 cubic feet per second, subject to the prior rights of the owners of the rancho and of the Fresno Canal, to the extent of 3,000 cubic feet per second, and subject also to the proviso that, for use on the ranch, 500 cubic feet per second may be taken out of the main canal of the district. The price paid by the irrigation district was $250,000 in district bonds, and the aggregate amount of land in reservoir sites and right of way for the canal was not to exceed 2,200 acres. As Sunset Irrigation District has been declared illegally organized, this agreement has lost its force and the bonds delivered have lost their value. The owners of the Laguna de Tache Rancho have always strenuously objected to the diversion of water from Kings River so long as their own needs were not fully met. The many lawsuits instituted have led to agreements with the various canal companies, particularly with those receiving their water supplies from Murphy Slough. The agreement entered into with these canal owners led to the formation of the Murphy Slough Association, which has already been referred to.

CRESCENT CANAL.

This canal was constructed in 1885 and 1886, and came into use in 1887 for the irrigation of lands on the western edge of the extreme southern portion of Fresno Swamp. The head of the canal is on the south side of North Fork, about a mile to the north of Summit Lake. The canal, which is about 8 miles long, has a westerly course for about 1.5 miles, thence northwesterly, following a grade line with a fall of 6 inches to the mile. It was originally made 50 feet wide near its head; it was 2 feet wide several miles below and 50 wide feet in its lower sections. The narrow section was cut to the full width in 1892. It was planned to carry water 3 feet deep.

The canal is owned by a company incorporated in September, 1885, whose capital was fixed at $75,000, in 150 shares, of which 29.5 were issued. The cost of the original canal works is reported to have been $33,120. The canal construction was for the benefit of its stockholders and for the irrigation of their lands, and not for the sale of water. In 1899 the canal was extended upstream about 2 miles to effect a better control of the water at its head. This extension is reported to have cost $5,600. Each share of stock entitles its holder to water for the irrigation of 320 acres. After all stockholders have been supplied with water the surplus is sold at the rate of 75 cents per acre per irrigation. About 9,400 acres are reported to be under irrigation. Individual stockholders are allowed to dispose of the water to which they are entitled. The rental price of water obtained from stockholders is generally from $100 to $200 per share of stock per season. Canal expenses are met by levying assessments upon the stock. The estimated cost of delivering water is 25 to 40 cents per acre irrigated. The owners of the canal have been and are involved in litigation with the owners of the Stimson and the James canals and of the Laguna de Tache Rancho. In litigation with the owners of the Stimson Canal the Crescent Canal was awarded 213 cubic feet of water per second. It is reported that this awarding is acknowledged in all agreements between the Crescent Canal owners and the owners of the Laguna de Tache Rancho. The original regulator or canal headgate had a width of 50 feet. It was a light, simple structure, weighted on top with a filling of earth. The new headgate is well made of light timber. It is 40 feet wide, divided into 10 openings by vertical posts, openings between posts being closed with loose flashboards. The estimated capacity of the canal is about 406 cubic feet per second.

STIMSON CANAL.

The Stimson Canal is owned by the Stimson Canal and Irrigation Company, which was incorporated in February, 1891. The canal was constructed in 1889, at a cost of about $23,000. This canal irrigates some of the reclaimed lands of Fresno Swamp. It diverts water from one of the high-water channels flowing in a southerly direction through this swamp, being the same channel—Bogg Slough—which supplies water to Crescent Canal. (Fig. 16 C.) An agreement has been reached between the two canal companies under which a partition of waters is effected at the head of the Crescent Canal. Under this agreement the Crescent Canal receives 213 cubic feet per second and the Stimson Canal 165 cubic feet per second. In an agreement with the owners of the Laguna de Tache Rancho the right of the Stimson Canal to 185 cubic feet per second is recognized. The area irrigated by the canal has been reported at 14,000 acres. Its capacity is about 120 cubic feet per second. The cost of canal maintenance is reported to be about $650 per year. Water is apportioned to stockholders or to persons who have rented stock in proportion to the number of shares held. Surplus waters have at times been rented at the rate of 50 cents per acre per irrigation. The estimated cost per acre of effecting a delivery of water to the land to be irrigated is 25 to 40 cents. The structure in Bogg Slough at the head of Crescent Canal serving to control the partition waters was built at the expense of the Stimson Canal Company. It serves as a weir in the slough. Its width is 48 feet, and it is reported to have cost $1,100. The weir or gate in Bogg Slough at the head of Stimson Canal is a massive structure, 54 feet wide, erected at a cost of $2,000, and was built in 1897. The canal headgate was originally a light structure that cost about $400; it was washed out in June, 1894, and replaced by a new gate, 40 feet wide, at a cost of about $600.

CALAMITY DITCH.

The Calamity Ditch was constructed in 1894. It is a high-water ditch about 16 feet wide on the bottom, having its headgate located near the edge of the swamp and overflow land about a mile to the northward of Summit Lake and just south of Crescent Canal. The ditch has a northwesterly course, is several miles in length, and supplies water for about 1,500 acres of land. Its cost of construction is reported at $1,000, and the annual expense of maintenance $100. Water is generally available from the beginning of May to the end of July. The ditch is owned by the landowners whose farms are served with water by it.

HITE DITCH.

The Hite Ditch was originally constructed as a branch of Stimson Canal, but owing to the unreliable flow of water in Stimson Canal, due largely to litigation with the owners of the Crescent Canal, an independent diversion of water was effected by the irrigators whose lands were served by the Hite branch. The ditch was constructed several years ago. It has a headgate 9 feet in width, placed in the reclamation levee on the west side of Bogg Slough, near the point where the Stimson Canal receives its water. This ditch receives water only for a short period each year, and irrigates about 500 acres of the reclaimed lands in Fresno Swamp. The ditch is but poorly maintained, and is reported to have a capacity of 15 to 20 cubic feet per second.

JAMES EAST SIDE CANAL.

The James East Side Canal receives its water from the eastern side of Murphy Slough, just above the head of Steamboat Slough, which is one of the water courses of the Fresno Swamp region. It has a northwesterly course for a distance of about 15 miles, skirting the easterly edge of the submersible lands of Fresno Swamp. The canal was constructed by J. G. James in the fall of 1885. It was made 10 feet wide on the bottom and to carry water 2 feet in depth; width and depth have been gradually increased to a present bed width of 20 feet and a depth of 4 feet. Water is admitted into the head of the canal without being under control of a check weir or headgate, and parts of the canal have assumed the appearance of a natural waterway. Water from this canal is used only for grass-land irrigation. It is reported that as much as 5,000 acres have been irrigated in one season. The canal capacity has been estimated at 75 cubic feet per second.

JAMES WEST SIDE CANAL.

The James West Side Canal was constructed in 1892–93 by J. G. James along the western margin of the Fresno Swamp lands. The point at which it diverts water from one of the Fresno Swamp sloughs is about 8 miles below the point at which the East Side Canal receives its water. In 1889 the original West Side Canal was paralleled by a second canal receiving water through the same headgate which supplies water to the former. The second canal occupies a position about one-quarter to one-half mile farther west than the original one. Each of these canals has a length of about 10 miles; bed widths are reported at 40 feet and depths at 3.5 feet. About 2,000 acres of land can be irrigated from these canals. It is reported that about 12,000 acres have been served with water. The crops irrigated are principally wheat and corn, water being delivered to tenants of the land free. The tenants are, however, required to keep the canal in repair.

PUMP IRRIGATION FROM FRESNO SLOUGH.

The main slough draining Fresno Swamp and uniting with the San Joaquin River at Las Juntas is known as the Fresno Slough. When Kings River is in flood and the delta branches flowing northward carry water into Fresno Swamp there is a considerable discharge through this slough into San Joaquin River, but there are times when Kings River contributes no water to this slough, its water being then dead or without current and kept at the ordinary summer stage by contributions from San Joaquin River, whose flow is checked just below Las Juntas by the dam or weir of the San Joaquin and Kings River Canal and Irrigation Company. On this slough, at points about 8 to 12 miles above Las Juntas, are four pumping plants which have recently been put into service for the irrigation of lands upon either side of the slough. As the banks of the slough are very low and the lands extending away from the banks upon either side thereof are very flat the cost of thus pumping water is very low and the irrigation of large areas of land is readily affected.

WHITESIDE PUMP.

The Whiteside Pump is the uppermost plant located on Fresno Slough. It was installed in 1899. Power is supplied to a 16-inch centrifugal pump by a 60-horsepower portable engine. Water is raised only 4 to 10 feet, according to the stage of water in Fresno Slough. It is delivered into a ditch having a width of 10 feet and irrigates about 1,500 acres of land on the southwest side of Fresno Slough. The plant is maintained and operated by the tenants of the land irrigated.

MITCHLER PUMP.

The Mitchler Pump is located about a mile below the Whiteside Pump, on the opposite bank of Fresno Slough. The 26-inch centrifugal pump at this station is driven by a 150-horsepower stationary engine and delivers water into a ditch 30 feet in width. It is claimed that about 7,000 acres of land have been irrigated with this pump at a cost of 25 cents per acre. The cost of the plant is reported at $8,000. It was constructed in 1899 and is operated by the tenants of the lands irrigated.

THE LEE PUMP.

The Lee Pump, which also draws water from Fresno Slough, is located upon its westerly bank, a little over a mile below the Mitchler Pump. The 16-inch centrifugal pump at this station is driven by a 40-horsepower movable engine. About 1,500 acres of land are reported to have been irrigated with its water at a cost of 20 cents per acre. The water is delivered into a ditch having a width of 15 feet. The plant was installed in 1898.

BORLAND PUMP.

The Borland Pump is located on a small west-side branch of Fresno Slough, about 1.5 miles below the Lee Pump. This plant was installed in 1899 at a cost of about $8,000. The 26-inch centrifugal pump is driven by a 150-horsepower engine. Two thousand acres are irrigated with its water at a cost of 30 to 35 cents per acre. The owner of this plant is involved in litigation with the owners of the San Joaquin and Kings River Canal, who claim that the taking of water from Fresno Slough for irrigation purposes is adverse to their interests.

The irrigation accomplished by the several pumping plants just enumerated is supplemented by a fifth portable plant, which is put in service at any point of the slough where most required.

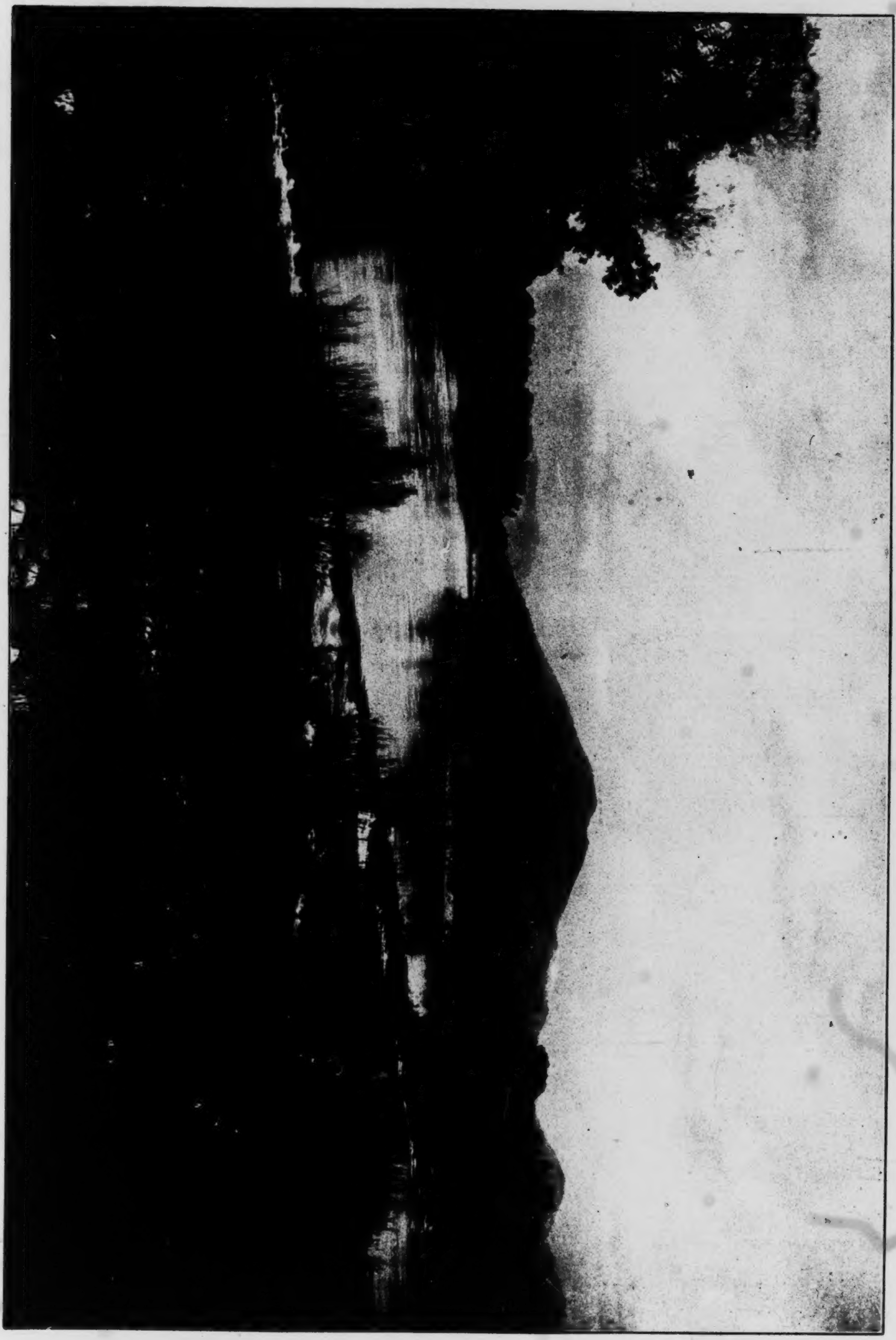
METHODS AND PRACTICE OF IRRIGATION.

Of the Kings River canals only one is owned by an irrigation district. One is owned by a corporation whose canal interests are entirely separate and distinct from the ownership of the land irrigated.

The rest of the canals are owned by companies or corporations whose stock is for the most part in the hands of the landowners. The stock in such cases generally represents a proportional interest in the water, and the stockholder becomes a preferred user of the water. Sometimes the canal company sells surplus water to landowners who hold no stock; sometimes the individual stockholder is permitted to sell his surplus in this way. This practice occasionally disturbs the reliability of service, as it occasionally results in the call for more water through a canal branch than it can supply.

The irrigation works on Kings River are throughout of a cheap but effective character, serving their purpose fairly well, but typical in a measure of the unsettled conditions relating to the rights to use water. Permanent structures are practically unknown. The dams in the main channel of the river—the designation "weir" would perhaps be more appropriate—are constructed of cobbles and brush, repaired as may be necessary after each freshet (Pl. XXVII). The water not diverted flows over these and they are frequently cut out in whole or in part during the flood stages of the river, but are easily replaced. Water apportionment to the several canals would be greatly facilitated if there were fewer points of diversion; if, for instance, the canals of each group could be served through a common trunk canal. The canal gates throughout are timber structures; some of heavy, some of very light materials. A well-constructed gate serves six to ten years and is so inexpensive and easily adjusted to varying requirements that it will probably be long before any masonry structures will be seen on the river.

There is not a canal or ditch on the river which has yet introduced a careful system of water measurement, or even of apportionment, to irrigators. This is due to several causes. In the first place, water is not sold as an ordinary commodity. In every canal, even when the quantity to be delivered is specifically named, the unit of measurement represents only a proportional part of the flow of the canal, based on the number of shares of stock owned or rented, on the number of water rights held, or upon the area to be served with water. This apportionment is not



COBBLE AND BRUSH DAM IN KINGS RIVER.

carefully made, but is left to the good judgment of a canal superintendent, who generally manages to give irrigators all they want in times of abundant flow, and who stands them off as best he can when water is scarce. In the second place, there is very little call for water measurement in a district like the Mussel Slough country, where irrigation progresses without application of the water to the surface of the soil. Crops may be benefited as much, or even more, by the water sinking from ditches in adjacent tracts as by that brought to the land under cultivation; the same is true of some districts near Fresno, where ground water has risen so near the surface as to make the application of water to the surface unnecessary. The system of apportioning water has led to the adoption of methods of regulation by means of gates with water flowing through submerged orifices, or others with a clear overfall, giving the irrigator reasonable assurance of fair treatment. Such measurement is, however, only intended to be relative. When a number of irrigators receive water through a common private ditch they arrange among themselves how it shall be apportioned as to time and quantity.

Very often the owners of adjoining tracts of land enter jointly upon the construction of laterals from some main canal, and the affairs of these laterals are managed in a manner very similar to those of independent canals. The Enterprise Canal was originally of this type. It was constructed as a branch of the Fresno and Kings River Canal, but is now considered a branch of Fresno Canal. Others are the Herndon Canal, Hansen Ditch, Central Colony Canal, Washington Colony Canal, Briggs Canal, Malaga Extension Ditch, Garfield Ditch, McCall Ditch, Highland Ditch, Bethel Ditch, Kirby Ditch, Wristen Ditch, Iowa Ditch, Harlan and Stevens Ditch, Caruthers Ditch, Wildflower Ditch, Webber Ditch, and others.

The methods of irrigation as practiced in the various districts served with Kings River water are fairly well adapted to local requirements. Physical conditions, character of soils, the originally extremely dry condition of the plain lands, as well as the subdivision of land into very small holdings, were the prime factors which determined the methods of applying water to land on the plains or uplands upon both sides of Kings River. The ease with which an elevation of the ground water could be controlled in the delta region, particularly toward the south, in the so-called Mussel Slough country, very naturally led to the adoption of a method of irrigation in that region which has remained peculiar to itself. Irrigation is here accomplished by leading water into small irrigating ditches, generally 100 to 200 yards apart, in which it is allowed to flow sluggishly until enough water has found its way through the surface and into the subsoils to saturate them with water and bring the ground water plane to within a few feet of the surface soil. When moisture is thus brought within reach of the roots of grain, alfalfa, trees, or vines, irrigation is complete for the season. This occurs at the time when the available supply from the river is about exhausted. Due to evaporation from the surface of the soils, the consumption of moisture by plant life, and the sinking of the soil water into deeper porous strata, the surface of the ground water falls lower and lower, until at the beginning of the next irrigating season it is from 6 to 12 feet below the ground's surface. Under this system of irrigation the movement of moisture throughout the great body of the surface soil is upward. The water which thus moves from below to the surface brings with it more or less of alkaline salts, which, when water evaporates at the surface of the soil, often accumulate in undesirable quantity. The extent to which lands in the delta region of Kings River have through this cause been deteriorating is often remarked, but as yet no steps seem to have been taken to correct the evil. Many examples of such deleterious effect upon the soils are found on the north side of the river as well as on the south.

Near Fresno, where the original holdings of land were small and where the quantity of water available for irrigation was also small in proportion to the demand, it was quite natural that unusual effort should have been made to thoroughly prepare the land for irrigation before applying the water. It became customary to subdivide fields into small, rectangular tracts, often only one-quarter acre or less in area, and to make the surface of those tracts perfectly smooth and level. Each rectangular plat of ground was surrounded by a low embankment, and irrigation was effected by flooding its surface. Irrigation was complete as soon as water covered the entire plat. Any excess of water was allowed to sink into the soil. During the first years of irrigation near Fresno, while the soils and subsoils were very dry and ground water was at depths of from 30 to 60 feet below the surface, the quantity of water absorbed was sometimes far in excess of what would ordinarily be considered possible. Five feet of vertical depth were occasionally applied at a single irrigation. The quantity of water put upon a single plat during a season would occasionally be equivalent to a depth over all of 20 feet. This system of flooding in small rectangular tracts was gradually modified to a system of furrow irrigation. Furrows were also used to a considerable extent in irrigating grain land and orchards, irrigation in such cases being effected by turning the water into deep plow furrows which, according to the amount of surface fall of the ground, were carried in a direction of greatest slope, or quartering across the same in cases when velocities along lines of greatest slope would cause too great erosion. To some extent the method of irrigating in contour checks came into use, but it has not found general favor, the irrigating heads being generally too small to use this system to advantuge. The application of water to land commences each season in March, or as soon thereafter as the canals are well supplied with water. At this time water is applied to grain lands, to orchards, and to vineyards. The irrigation of alfalfa usually begins a month later. One irrigation is ordinarily considered ample for orchards and vineyards, but when spring rains are scant and the soil has not been thoroughly wet by winter rains, irrigations are repeated if water is available. Alfalfa is generally irrigated once for each crop cut, the number of waterings it receives per year being generally 3 to 5. Very little grain land is irrigated by application of water to the surface. This is generally done only when it appears possible thereby to save a crop which it was hoped would mature without irrigation.

The large volume of water which is annually diverted from Kings River and sinks, from the many irrigation canals and from branches and the small irrigating ditches and through soils flooded into the subsurface strata, has gradually saturated the subsoils and brought the ground water so near the surface of the ground that it has become necessary in many localities to construct works for drainage. Numerous examples of this kind can be cited. A notable example is in the region to the east and south of Fresno. Drain ditches 4 to 6 feet deep have now replaced the irrigation ditches from which a few years ago water was spread over the surface of the ground.

It thus happens that very large areas of the lands classed as irrigated and benefited by canal water no longer have the water spread over their surface. The drainage works thus far introduced are all merely local, and no systematic attempt to prevent an undesirable encroachment of the ground water upon the surface soils nor to intercept the frequent freshet floods of the small foothill streams has yet been made.

THE PRESENT SITUATION.

To terminate vexatious litigation between the users of water from Kings River a number of agreements have been entered into amounting to a mutual recognition of rights of water. Rights thus conceded are not defined by a judicial tribunal, and such agreements are probably without force and effect as against any other claimants. There is in such agreements more or less danger that amounts of water may be mutually conceded far in excess of the amounts actually appropriated and put to beneficial use, the foundation being thereby laid for obstructing the putting of the river's surplus to any new uses. To give such agreements greater force, friendly lawsuits are sometimes instituted, and, on the basis of the testimony furnished, decrees are rendered confirming them. This would be a step in the right direction if the machinery of the court were such that the facts could be verified, and if, at the same time, the rights of other appropriators were under consideration and could also be thoroughly investigated. It does not appear that at this writing the right to the use of water from the river has been clearly established, in so far as quantity to be diverted is concerned, for a single Kings River canal. The agriculturist, therefore, whose whole interest depends upon a continued supply of irrigation water and upon the rights of the canal from which he is supplied, can not be secure in his position until this question of right to use is settled. The delay in the settlement of all these matters is largely due to the fact that the appropriators, who were in most cases landowners or corporations formed by landowners, preferred to submit to a certain measure of injustice rather than to enter upon expensive litigation. Now that demand at times calls for more water than the streams can supply, the evil results of permitting every water user to regulate his own taking are becoming apparent. The irrigator is forced into court to protect himself, and attempts are made to adjudicate rights. The results are not satisfactory; nothing short of an injunction issued by some judicial tribunal will shut down the headgate of an upstream canal which, by reason of its position, has the first chance at the water of the stream, but whose rights are perhaps subject to the prior rights of many of the downstream canals or ditches. But the shutting down of the gate is generally unnecessary. Regulation is required, and the regulation should be in the hands of some State authority.

The recourse which has been had to the courts and which has led to the issuance of injunctions against canals and ditches, now serves to emphasize the need of such regulations. This is recognized, as already stated, by the canal owners, who, by forming combinations of canal interests, strengthen the cause of one irrigated section against adverse interests. They endeavor in such cases to secure by agreement with possible adverse claimants a recognition of their rights, thereby securing in a measure the protection which the laws of the State have failed to give.

No appropriator, however small his claim may be to the use of water, should be allowed to perfect his claim, or to put the water to the intended use, without the sanction and protection of the State. Such protection can not be assured until the State takes cognizance of the amount of water at its disposal and limits the amount assigned for use to the available supply. Herein, above all, lies the necessity for continued investigation.

The industries as now established need protection. The users of water should have their rights defined. It must be determined under what conditions of flow in the river a ditch shall receive water, and how much, and in that right to receive its water the ditch must be protected beyond peradventure.

It is not wise to longer permit each canal owner to take water if he can get it, with shotgun protection if necessary, nor, when the canal company and its officers are all enjoined from opening gates, to let the irrigator turn in water despite court injunctions. Either the canal has a right to use water and must be protected therein, or it has no right, there being a prior or a higher established use for the water somewhere else, and then the law should be enforced.

The cause of the uncertainty of the right to use water, either under the riparian doctrine or by appropriation, is due to the indefiniteness of the law and the insufficiency of the machinery for its application. Where appropriations are in question, the uncertainty of the rights acquired has been already sufficiently emphasized. Under the common law, as interpreted by our courts, each case must be settled on its own merits; there is no specific rule that can be applied. The only remedy, under the circumstances, appears to be for the State to step in at once and provide machinery for the speedy determination of established rights of whatsoever character, and to give definiteness to the rights of all claimants. It will thereby be placed in position to determine what are surplus waters, and the way will be open for such further irrigation development as circumstances warrant.

Canal management is generally most businesslike when the canal is owned by persons, companies, or corporations who are not landowners, but are merely the agents for distributing the water to consumers; but, notwithstanding this fact and despite the probability of less intelligent management, there seems to be no question that canal ownership by the same persons who own the land is far to be preferred. The ideal arrangement would be the ownership in the irrigating canal or ditch in exact proportion to acreage that is to be irrigated. Land and the use of the water necessary to make the land productive should not be separated in ownership. It is only thus that fullest benefit from the use of water can be secured; it must not alone be used economically by the irrigator and handled without unnecessary waste in transit from stream to the lands to be benefited, but the irrigator must know that he is secured in his own rights so long as he complies with his part of the contract.

One matter just touched upon which interests all irrigators and which particularly interests the State at large is the economical use of water. Whether water is allowed to run to waste, perhaps on demand of a riparian owner, or is used in a wasteful manner, either by a riparian owner, by a canal company in effecting distribution, or by the individual irrigator, or whether it does duty on crops of low economic value when it might be put to higher use, injury to the community at large is the result.

So soon as the canal capacities become so large as to leave no surplus flow in the stream for further canal development, while the lands commanded are not yet all supplied, the taking of measures to restrict waste wherever possible, and to make the water ordinarily wasted do full duty, should be considered imperative. Education in this direction should not be neglected. The good work already done by various United States and State departments in this direction is to be highly commended and the example should be followed in this State, which is one of the foremost in the matter of extent of irrigation, but one of the last to give its irrigators much-needed aid and protection.

The study of methods of water measurements, delivery of water to irrigators, and the application of water to the soil, becomes of great importance. Each State must be prepared to meet these questions, and wherever irrigation is of considerable extent this can be done only by a department with broad duties and permanently established. Such investigation can not be terminated in a year or two, and should continue indefinitely, as there will be much to learn, even after the conditions in irrigated sections have become fairly permanent. The State should not be slow in aiding the agriculturist, even if the aid stops with good advice; neither should it be lax in protecting his rights to the moisture which the soil needs any more than in protecting him in the possession of the realty itself.

But little control has been exercised in the past by the State of California over the conditions imposed by canal owners upon the takers of water. The law provides that lands once served with water from any canal from which water is sold have equal rights with all other lands in their class and can not be deprived of their right to receive water at the pleasure of the canal owner. Otherwise canal owners make regulations to suit themselves. This is fairly well illustrated in the remarks made upon canal management and water distribution in the foregoing pages, for each of the more important irrigation works described.

The rates charged by any canal owner for water are subject to regulation by the board of supervisors of the county in which the water is for sale. There has been but little demand for such regulation in Fresno, Tulare, and Kings counties, because it seems questionable whether the water-right agreement is subject to such regulation, and because where rates are charged the irrigators are, for the most part, stockholders in the canal company, and would have to contribute to canal expenses as stockholders if the amount collected from ratepayers should prove insufficient to meet expenses. There is, therefore, but little occasion for complaint. It seems questionable whether the power to fix water rates, or, rather, whether the power to appraise canal valuation as a basis for fixing water rates, should be intrusted to such bodies as supervisors. The rates are to be fixed so as to yield a fair return on the value of the works in actual use. This value should be appraised by some State rather than by a local department, and the value determined should serve as a basis for the rates in all of the several counties in which water is to be sold by any canal. The canal appraisement presents particular difficulties when values of franchises are involved. These have value according to their earning power, yet it rests at present in the power of the rate-fixing body to destroy such value entirely by fixing the entire valuation so low that the earnings are scant interest on only a nominal franchise value. Difficulty often arises, too, when canals are located in two or more counties. The officials of one are not bound by the acts of another, and there may be as many maximum rate scales established for a canal as there are interested counties. The fixing of water rates has always been a fruitful source for charges of official corruption and has led to much litigation. Whenever the landowners themselves own the canals, and the charge or assessment is graded from year to year to barely meet the expense of canal maintenance and management, there appears to be no further need for the regulation of the water rates.

Comparatively few canal companies have been organized in central portions of the State for the sale of water to irrigators. When the canal companies are not controlled by the landowners who are served with their water, agreements or water contracts are usually entered into under which the landowner obligates himself to pay a stipulated sum annually to the canal company. He is charged an annual rate for canal management and maintenance. It is generally assumed that such water contracts and annual rates paid are not subject to regulation as in ordinary cases of sales of water.

These contracts appear defective, particularly in this, that no intent is disclosed of ever transferring the canal ownership to the landowner who virtually has paid for the canal construction. The $10 per acre, or whatever price may have been fixed by the canal corporation, is a payment for the privilege of receiving water. It is practically a bonus paid to the canal company. Such payments are often agreed upon by landowners before canals are built to encourage and aid in the canal construction. It is then a recognition of the unearned increment, a voluntary contribution made to an enterprising ditch or canal builder, in consideration of the value added to the land when it is brought under ditch. When such bonus is paid to the owner of a canal already constructed, the contract made takes the form of a water-right agreement. As the bonus so paid is usually fixed high enough to reimburse the ditch owner for his original outlay and for the risk he has assumed, it would seem a desirable arrangement to have the canal ownership pass to the water-right owners when a stipulated number of water rights have been sold. No canal enterprise has yet been inaugurated on these lines in this section. All canal companies selling water rights retain their ownership intact when water is sold to full canal capacity.

If it be granted that rights have been vested, whether under the common law or otherwise, then the taking of water to the detriment and actual damage of lands in which such rights are vested, should be under the right of eminent domain, and after due process of law full compensation for such taking should be made. Moreover, the taking of waters for irrigation which are not surplus waters should then be permitted only when irrigation can be shown to be a higher use. On the other hand, when there is no actual damage no one, even with prior vested rights, should have the right to interfere with new enterprises. There should then be some means of determining what waters are available for appropriation in excess of those necessary to be left in the streams to satisfy the needs of riparian owners and of prior appropriators.

This has not been the case in the past, and it is rather surprising that there has not been greater interference by riparian owners with irrigation works than has actually taken place. This is due mainly to the fact that riparian owners have not had immediate important use for the water themselves, and have been reluctant to plunge into expensive and protracted litigation; they have, too, in many cases asserted their riparian rights only to better themselves as appropriators.

How completely ownership in the waters of a stream is sometimes assumed is illustrated by the agreement covering a sale of water and of land which was made by the owners of the River Ranch (Laguna de Tache Rancho) with the now defunct Sunset Irrigation District in 1892. The control of the Fresno Canal and Irrigation Company has passed into the hands of English capital. The controlling interest is reported to be held, as already stated, by the same persons who control the Kings River and Fresno Canal, and who are the principal owners of the great riparian tract—the Laguna de Tache Rancho. This is the riparian land whose former owners secured decrees of court forever restraining the same Kings River and Fresno Canal from diverting any water at all, and which also secured similar decrees against the Fowler Switch Canal and the Centerville and Kingsburg Canal, and a decision almost as sweeping against the 76 Canal. According to the agreement referred to, George Clarke Cheape and his associates, owners of the Lagunda de Tache Rancho, assumed the right to sell of the waters of Kings River to the extent of 3,500 cubic feet per second, but in making this sale compelled a recognition of the prior right of the Fresno Canal to 3,000 cubic feet per second, and of the prior right of the Grant Canal, irrigating the Laguna de Tache Rancho, to the extent of 500 cubic feet per second. The price agreed upon and paid for this water and for about 2,200 acres of land was $250,000 in irrigation district bonds.

This transaction is a forceful indication of the extent of the rights sometimes assumed to be conferred by the riparian doctrine, and seems to be a literal interpretation of the right to have the river water—in flood as well as at its lowest stage—flow undiminished in quantity. Such an interpretation would, it is quite evident, make it possible for the most favorably located riparian owner, the one owning lands farthest downstream, to levy upon every appropriator above, whether he is damaged in fact or not.

NEED OF A DEPARTMENT FOR WATER CONTROL AND INVESTIGATION.

The existing conditions of Kings River, which are typical of those which prevail on Kern, Tule, Keweah, San Joaquin, Merced rivers, and other streams of the San Joaquin Valley point to the need of a State department to determine established rights to the use of water, to measure the quantities of water that are available, to distribute the water to those who have rights, and to study the economic use of water and the possibilities of water storage, and of water conservation.

When the question arises as to how such a department shall be organized, it will be well to look to other States where experience has already been had.

It is not the intention of this paper to elaborate a scheme for this purpose. There is no reason why it should not succeed here as well as in Wyoming. The department should have certain judicial functions. Its acts should be subject to review and confirmation by the courts. Its duties need not be restricted to the irrigation inquiry alone, but may be extended to drainage and to such other matters as are ordinarily assigned to departments of public works. In this department all rights to the use of any water heretofore granted, or to be granted, by the State should be recorded, and in it a careful and complete record of the physical facts relating to each water appropriation should be preserved.

In determining the measure of the right to use water, not only ditch capacity and amount diverted should be taken into consideration, but also the acreage irrigated. It is not necessary to assume that any particular acre of land will require just as much water as any other acre, as this will depend largely upon the physical character of the land served, upon the nature of the crops cultivated and for which the land is suitable, and upon the amount of rainfall. But when these facts and all others affecting the needs of any tract of land, or of a district, are taken into consideration, some conclusion can be reached as to the extent of past or prospective beneficial use.

Applications for a grant or franchise for the use of water for any particular purpose should rather specify this purpose with precision, than the amount of water desired. Competent State authority should issue the water right, with a clear definition of the right thereby conferred.

The establishment of such a department should not be delayed. The problems to be solved are becoming more complex from year to year, and can be settled with less friction now than at any future time. Their final settlement will be a potent factor in establishing the prosperity of the districts now irrigated and of others for which water can be made available, on a sound and permanent basis.

CONCLUSIONS.

The conclusions reached as a result of this inquiry may be briefly stated as follows:

(1) No water rights are as yet clearly defined, either by the records or by decisions of the courts.

(2) The extent and the priority of established rights to water and to the use of water should be ascertained and clearly defined, and the necessary water should be allotted to riparian owners and to appropriators in accordance with their needs and their rights.

(3) The available supply from each stream should be determined and apportioned to those who have the right to use it—all surplus to be at the disposal of the State.

(4) The right of every bank landowner to use water should be as clearly defined as the right of the appropriator, and the measure of his right should not be the possible future use.

(5) Due consideration should be given to priority of use as between appropriators, as well as between riparian owners.

(6) The distribution of water to the canals and ditches should be under State control.

(7) The study of the available supply and of the use of water for irrigation should be carried on by the State and by the Federal Government. Duty of water and methods of irrigation, canal structures, canal management, and water distribution should receive special consideration, and the work done by the State should supplement similar work being done by the U. S. Department of Agriculture and by the U. S. Geological Survey, and the results should be brought within convenient reach of all interested parties.

(8) The right of eminent domain should be given to every person, company, or corporation to whom the right to use water has been duly allotted by competent authority, in order that condemnation proceedings may be had whenever necessary to take private property for a higher use.

(9) A complete record of water rights for the entire State should be kept in a State office, and these records should show not only, as at present, the original intent of the claimant, but also the allotment of water by the proper authority, the date of ditch or canal construction, the dimensions of the finished structure, its ordinary flow, and its capacity; also subsequent enlargements and all other facts that are essential in comparing its claim to water with those of other canals or ditches taking water from the same stream. History and records of this kind can not be made by the water appropriator, but should in large part be the result of original inquiry and measurements by State officials.

(10) Litigation is not leading to a satisfactory solution of the water-right problems. The fault is not so much with the courts as it is with the uncertainty of what is to be considered law. There is no intelligible rule of decisions. Each case is peculiar to itself. No irrigator can ascertain his rights without an analysis of common law as applied in countries and under conditions that are hardly comparable with those here prevailing.

(11) Some method should be devised for establishing rules of decision in water-right matters that will rest on a positive basis and that will not be susceptible of varied interpretation.

(12) The right to water or its use should pass to the land served and should remain attached thereto. Canal owners should be considered common carriers.

(13) The flow of the river should be increased at the low-water stage so far as practicable by water storage in mountain reservoirs.

(14) All rights conferred under franchises, or as special privileges, should, at the termination thereof, pass to the people benefited, and such franchise or privilege should not be renewable without their consent.

APPENDIX.

EVAPORATION EXPERIMENTS ON KINGS RIVER.

The following tables contain the results of evaporation experiments made by the State engineer's department of California[1] in the years 1881 to 1885 at Kingsburg, on Kings River.

The pans used in making these observations were 3 feet square and 15 inches deep. The water surface was maintained about 5 inches below the rim of the pan, the required position being indicated by a metal galvanized iron pin rising in the center of the pan to the desired height. The point of this pin was kept barely submerged.

The amount of water required from time to time to restore its surface in the pans to a normal elevation was measured in standard cups prepared for the purpose and graduated to represent depth of water in the pan for which used.

One pan was floated in the river, another was kept on the bank. The pan on the bank, referred to as the pan in the air in the tables, was, after the first three months, set into the ground a few inches and earth was banked up around its sides to the same elevation as the water in it. It had full surface exposed to sun and wind. During November and December, 1881, and January, 1882, this pan was on the railroad bridge, exposed on all sides to sun and air.

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[1] William Hammond Hall, State engineer. The department was abolished in 1891.

The observers at Kingsburg were instructed, among other things—

> To fill the pan to the normal plane once every day during summer months, less frequently at other seasons of the year.
>
> To take observations at the commencement of every fall of rain, and to restore the water surface to the normal plane at the end of every fall of rain.
>
> To keep a daily record of the temperature of the air, of the water in the pans, and of the water in the river.
>
> To keep a rainfall record.

The pan floated in Kings River was protected from the splash of waves by a wooden frame, into which the pan was fitted so as to float horizontally, without being protected from the sun or wind.

Evaporation at Kingsburg, Cal., November 1, 1881, to October 31, 1885.[1]

Period.	Time.	Temperature of air.	Pan in river.			Pan in air.	
			Temperature of river.	Temperature of water in pan.	Evaporation.	Temperature of water in pan.	Evaporated depth.
		°F.	°F.	°F.	*Feet.*	°F.	*Feet.*
November, 1881	4.30 p. m.	66	56	55	0.220	60	0.335
December, 1881	do	55	52	52	.050	55	.120
January, 1882	do	54	52	50	.090	53	.200
February, 1882	5 p. m.	56	55	54	.115	56	.105
March, 1882	5.15 p. m.	64	60	59	.180	66	.265
April, 1882	do	73	63	62	.260	72	.435
May, 1882	5.45 p. m.	84	63	63	.305	77	.835
June, 1882	6.30 p. m.	88	67	68	.475	83	.940
July, 1882	do	98	80	81	.660	91	1.075
August, 1882	6 p. m.	96	84	85	.665	85	.875
September, 1882	do	81	73	73	.475	75	.575
October, 1882	10 a. m.	68	63	63	.135	60	.195
Total					3.630		5.955
November, 1882	10 a. m	53	52	52	.115	49	.100
December, 1882	do.	51	50	50	.085	46	.090
January, 1883	do.	43	44	43	.060	41	.040
February, 1883	do.	54	50	49	.100	52	.070
March, 1883	do.	69	63	62	.305	60	.310
April, 1883	do.	67	61	62	.270	61	.260
May, 1883	do.	76	61	63	.160	67	.310
June, 1883	do.	92	68	71	.500	77	.850
July, 1883	do.	96	82	84	.760	78	.970
August, 1883	do.	93	82	83	.920	75	.970
September, 1883	do.	88	78	79	.730	73	.705
October, 1883	do.	69	62	62	.400	57	.290
Total					4.405		4.965
November, 1883	10 a. m	59	55	54	.170	52	.140
December, 1883	do.	49	48	47	.080	44	.065
January, 1884	9 a. m	47	48	48	.105	44	.075

[1] See Physical Data and Statistics, William Hammond Hall, State engineer, 1886.

Evaporation at Kingsburg, Cal., November 1, 1881, to October 31, 1885—Continued.

Period.	Time.	Temperature of air.	Pan in river.			Pan in air.	
			Temperature of river.	Temperature of water in pan.	Evaporation.	Temperature of water in pan.	Evaporated depth.
		°F.	°F.	°F.	*Feet.*	°F.	*Feet.*
February, 1884	9 a. m	52	52	52	0.050	49	0.066
March, 1884	do	61	56	57	.090	57	.105
April, 1884	do	67	60	61	.160	61	.180
May, 1884	do	76	59	61	.320	69	.400
June, 1884	do	77	57	60	.295	61	.505
July, 1884	do	83	61	63	.380	73	.670
August, 1884	do	78	64	66	.370	69	.670
September, 1884	do	75	63	63	.320	64	.520
October, 1884	do	68	62	68	.350	60	.310
Total					2.690		3.700
November, 1884	9 a. m	58	58	57	.200	55	.120
December, 1884	do	50	48	47	.180	48	.140
January, 1885	do	48	50	49	.010	47	.010
February, 1885	do	54	53	53	.140	51	.130
March, 1885	do	65	60	60	.240	59	.220
April, 1885	do	68	62	63	.160	63	.270
May, 1885	do	75	63	65	.340	68	.660
June, 1885	do	77	65	68	.660	71	.810
July, 1885	do	84	72	74	.710	74	.900
August, 1885	do	86	72	72	.930	72	.930
September, 1885	do	79	74	74	.640	71	.660
October, 1885	do	71	67	66	.470	63	.360
Total					4.680		5.210

Average evaporation for four years, November 1, 1881, to October 31, 1885.

Month.	Pan in river.			Pan in air.		
	Evaporation.	Evaporation per 24 hours.	Evaporation per square mile.	Evaporation.	Evaporation per 24 hours.	Evaporation per square mile.
	Feet.	*Feet.*	*Cu. ft. per sec.*	*Feet.*	*Feet.*	*Cu. ft. per. sec.*
November	0.176	0.0059	1.89	0.174	0.0058	1.87
December	.099	.0032	1.03	.104	.0034	1.08
January	.066	.0021	.69	.081	.0026	.84
February	.101	.0036	1.16	.091	.0033	1.05
March	.204	.0066	2.12	.225	.0073	2.34
April	.213	.0071	2.29	.286	.0095	3.08
May	.281	.0091	2.93	.551	.0178	5.74
June	.483	.0161	5.20	.776	.0259	8.35
July	.628	.0203	6.54	.904	.0292	9.41
August	.721	.0233	7.51	.861	.0278	8.96
September	.541	.0180	5.82	.615	.0205	6.62
October	.339	.0109	3.53	.289	.0093	3.01
Total	3.851	.0106	3.40	4.958	.0136	4.38

A STUDY OF WATER RIGHTS ON THE LOS ANGELES RIVER, CALIFORNIA.

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DISCOVERY AND COLONIZATION.

Nearly four centuries ago, when the adventurous explorers of the unknown Pacific Ocean, following the shore of California, touched at various points, they found the land inhabited by savages. More than two hundred years later, when the Spanish missionaries, advancing along the coast, established the outpost of European civilization in California, they found the same race of people living in the same barbarous condition. Unlike the native races which dwelt in parts of New Mexico and Arizona, the Indian tribes of this region possessed no knowledge of the art of irrigation. Without irrigation agriculture was impracticable. Consequently progress toward civilization was impossible, and the inhabitants remained in hopeless barbarism.

The usual Spanish method of colonization was followed in the settlement of California. This plan, which had been successful in Mexico and Lower California, embraced three classes of communities—missions, presidios, and pueblos.

The first was due to the zealous efforts of the Spanish missionaries for the propagation of the Christain faith among savage inhabitants of the region. Beginning at San Diego, in 1769, a chain of missions extending to San Francisco was founded. This line comprised eleven establishments, spaced some 15 to 25 leagues apart, and usually situated on or near the coast. A second line parallel to the first, but at a convenient distance farther inland, was planned, and some of these missions were built at a later period. The missionaries undertook to minister to the temporal needs as well as the spiritual welfare of their converts. They clothed and fed them, taught them how to labor intelligently on the farms, to build comfortable dwellings, and introduced among them various kinds of domestic animals. Under their direction was begun the practice of irrigation, destined in future generations to become the most potent factor in the permanent development of California.

Each mission was provided with a small guard of soldiers for protection against possible uprisings of the natives. To serve as supports or rallying points in times of great danger from this source, and also as means of defense against attacks from jealous foreign nations, four presidios or military posts were interspersed along the line of missions. Garrisons were long maintained at these posts, and there were located the seats of government of the province, which for many years was of a military form.

Progress in the new province was necessarily slow; all things seemed to conspire against the success of the undertakings. The natural difficulties to be surmounted were great; the division of authority between ecclesiastic and military officers was not conducive to the best results; communication with the vice-regal Government in Mexico was slow and uncertain; costly errors were made; disastrous delays were suffered. Nevertheless, the missions were gradually extended and each establishment grew in wealth and influence.

Meanwhile both missions and presidios were a heavy financial drain upon the Government in Mexico. The mission farms had been successful from the outset, but they were hardly able to keep pace with the increased demands rising from the growing numbers of neophytes and other dependents of the missions themselves. Consequently they were able to do nothing toward the support of the presidios. Supplies of grain and other necessaries for the garrison had to be imported at great cost and serious delays from Mexico. The expense and inconvenience of this arrangement caused instructions to be sent to the governor to hasten the founding of the third class of settlements—the pueblos, or towns.

The pueblos were to have civil governments, practically independent of control of either clerical or military authority, although entitled to the aid and comfort of both. They were to devote their energies to the development of the material resources of the region, especially in agriculture, even then recognized as the only permanent foundation for a civilized government. Thus their establishment was properly regarded as the principal step toward the colonization of the wilderness and the real advancement of the new province. As early as 1776 two sites notably suitable for pueblos were selected. One on the Santa Clara River in the north, now the modern city of San Jose, was settled before the close of that year. Numerous delays prevented the occupation of the second chosen site, that on the Rio de Porciuncula in the south, and it was not until September 4, 1781, that the pueblo named Nuestra Señora La Reina de los Angeles (Our Lady the Queen of the Angels) was founded. The pueblo has become the flourishing city of Los Angeles; the Rio de Porciuncula is now known as Los Angeles River; but on this date began the history of water rights on the stream and the chain of private title to lands within the limits of the pueblo.

The original population of the pueblo of Los Angeles consisted of 12 settlers and their families, 46 persons in all. They were gathered in the older provinces and were induced to come here under the especial patronage of the Government. They were to be supplied at the beginning with live stock, seed, and farming implements, which advances were to be repaid from the products of the land. They were to receive stated sums annually for five years, to be paid them in clothing and other necessaries. Each settler was to be granted a house lot and a tract of farming land, and, in addition, all were to enjoy as a community the use of Government land for pasture, and for obtaining supplies of wood and water. They were also to be free from taxes for five years.

IRRIGATION IN THE PUEBLO.

The subject of irrigation was given prominent place in the governmental order which directed the establishment of the pueblo. The site was to be chosen with particular reference to irrigation necessities, and the point for diverting the water of the river which would serve the greatest area of land was to be indicated. Many references to irrigation exist in the earlier ordinances and official correspondence, some of which it is claimed tend to support the theory that it was the intention of the Spanish Government to grant to the pueblo the absolute and exclusive ownership of all the water of Los Angeles River. It is also asserted that up to the beginning of American domination in California the municipal authorities had exercised full control over the diversion and distribution of water from the river, and, furthermore, that the present city, as the successor of the old pueblo, is entitled to all the rights and privileges granted to or acquired by the latter. American supremacy brought the old English common law of riparian rights. The conflict which naturally ensued between claimants under that doctrine and those asserting the ancient pueblo right has produced much of the most extensive water litigation of the county. The cases involving the question will be referred to in detail hereinafter. The history of colonization of the region has been given at some length here as being explanatory of the peculiar rights claimed by succession to the pueblos.

LOS ANGELES RIVER.

Compared with prominent streams of the humid region, the Los Angeles River would seem of insignificant size, but by comparison with those of the arid region its importance is apparent. Its waters maintain the existence of the metropolis of southern California, the second city in size and importance on the Pacific coast, besides watering a large area of rich farming land in and around the city. The antiquity and peculiar nature of its water rights give it an especial interest.

Hydrographically the Los Angeles River is a remarkable stream. It rises in the southern edge of the San Fernando Valley a few miles above the city of Los Angeles. Its watershed embraces an area of about 500 square miles, ranging from precipitous mountains to smooth and gently sloping plain. The unusual topography of the basin produces a stream of considerable volume and exceptional regularity of flow. It is to these features that the original selection of the site of the pueblo and the permanence of the modern city are due. About 85 square miles additional area of watershed contribute something to the flow of the river at points below the outlet of the San Fernando Valley.

The total area of 500 square miles is composed of about 175 square miles of high mountains and 135 square miles of lower mountains; the remainder is plain. The first division contains peaks which rise to heights of 6,000 feet or more. The area is well exposed to the moisture-laden winds from the Pacific Ocean; its precipitation is comparatively heavy, its surface slopes are steep, and the run off is rapid. The second averages much lower in altitude than the first and receives correspondingly less rainfall. The plain area, owing to its partially sheltered exposure, receives less rainfall than even its low altitude would seem to entitle it to. But, on the other hand, by reason of the light slope of the surface of the plain and the open nature of the soil, practically none of the rain falling on this area is lost by run off.

It is only at times of unusual floods that a continuous stream extends from any one of the mountain tributaries to Los Angeles River. At all other times the mountain torrents discharge their waters upon the broad, flat plain of the valley, into which they sink and are lost to view. Pursuing their way south toward the ocean these underground waters are intercepted by the Cahuenga Mountains, an uplifted range which projects like a great wing dam across the south side of the San Fernando Valley, almost effecting a junction with the Verdugo Range on the east. The remaining gap, about 1 mile in width, is the only apparent outlet for the drainage of the entire watershed of 500 square miles. The greatly contracted width of the valley at the outlet naturally results in the rise of a considerable part of the ground water, and the flow thus brought to the surface forms Los Angeles River.

The San Fernando Plain extends some 12 miles north and south by 25 miles east and west, covering an area of about 185 square miles. It rises gently from elevations of 500 to 700 feet along its southern edge to heights of 1,100 or 1,200 feet along its northern border. Generally speaking, the soil of the valley is of excellent quality, but here and there are seen the scars left by occasional torrents from the surrounding mountains. Below the surface soil the bed of the valley is composed of débris and detritus washed down from the surrounding mountains. The thickness of this deposit is undetermined, but there is every reason to believe that it is of enormous extent. Many wells have penetrated to depths of several hundred feet without striking bed rock, one of them reaching to about 60 feet below sea level. The sands and gravels filling this vast basin perform the office of a great storage reservoir, conserving the otherwise wasted water of rainy seasons and equalizing the flow not only throughout the year but from year to year.

CLAIMS TO WATER ON LOS ANGELES RIVER.

In California all documents relating to titles to water rights, like those affecting real estate, are entered of record in the office of the county recorder of the county in which the property is situated. An attempt to ascertain the status of water rights along Los Angeles River disclosed some interesting but unsatisfactory conditions of the public records in this county. Prior to August, 1888, water rights were embraced in miscellaneous records, which term seems to have included almost everything except deeds. It is found that there are 79 volumes of these miscellaneous records, whose contents are indexed alphabetically by names of persons in 5 indexes. Detailed search of the indexes discloses the fact that entries of water rights were made in only 10 of the 79 volumes. These 10 volumes contain 1,147 water notices, which are intermingled with all sorts of miscellaneous records.

Since August, 1888, separate books have been devoted exclusively to records of water claims. Of these there are to this date 5 volumes and 1 index, covering 1,420 pages, containing 2,727 entries.

The magnitude of the task of examining the rights existing on any one stream will be appreciated when it is known that in keeping water records in this State no effort has been made to segregate them according to the different streams in the county, to classify the claims according to the intended use of the water, or to distinguish between the different classes of documents which may relate to the one subject of water. Anything in writing offered for record is forthwith copied into the already voluminous records of the county in chronological order of filing. The only classification is the alphabetical index of names signed thereto. Notices of appropriation are naturally the most numerous, and these are simply placed of record without regard to locality or the use for which the water is claimed. No question as to the existence of prior rights to the same water, the good faith of the claimant, or the legal sufficiency of the form of notice is raised at any time or in any manner. Unquestionably the records of Los Angeles County are incumbered with enormous masses of worthless claims to water, and this condition is constantly growing worse. The crowding already noticeable in the recorder's office is some criterion of what the congestion will be in future years.

For the purpose of this study of Los Angeles River the writer has examined each one of the 3,874 documents relating to water which appear of record in this county. A great many of the claims give no clue to their locality; others describe it so indirectly or so imperfectly as to require a prohibitory amount of time to ascertain from other sources what stream is affected thereby. The number of claims which clearly relate to the main body of the river is small. This is owing, probably, to the exclusive right claimed by the city. Large numbers of claims have been made to the water of the several tributaries or streams existing higher in the same watershed. These have been claimed in detail many times over, and much greater service has been expected from them than they are capable of supplying, at least under the present conditions.

The earliest recorded water claim in Los Angeles County bears date July 16, 1864, although it is well known that water was extensively used for irrigation more than eighty years before that date. It should be added, however, that there exist in the archives of both county and city a number of manuscript books in the Spanish language which contain miscellaneous documents antedating American occupation. These books have not been examined. They may contain records of water rights, but it is doubtful whether at that early period much attention was given to documentary records of this character. The open and notorious use of water was doubtless considered to be all that was necessary to perfect and to preserve a water right, and there are probably not a few old and well-recognized water rights in this county in force at the present time of which there is no record whatever, except possibly where mentioned incidentally in transfers of real estate. As it is, many of the earliest records of claims were evidently afterthoughts, as they refer to the long and continuous use of the water, or claim that the use began on a given date many years before.

In these records water is claimed for every conceivable purpose to which it could be applied. The predominating use stated in the notices has been changed from time to time. In the early days of the records mining was the principal use for which water was wanted. At a later period agricultural and stock uses were those most commonly specified. During "boom" times irrigation and municipal supply were almost invariably named, while at one time in recent years there was a widespread epidemic of schemes for utilizing water power to generate electricity for transmission to the surrounding centers of population. Usually the notices of each period embraced not only the uses popular at that time but also those of all preceding eras.

The wording of recorded claims shows how the estimation placed upon the importance of documentary record has changed from time to time. At the beginning, and for a number of years, the belief seems to have prevailed that actual use was the sole requisite for a title to water. This idea was not far wrong, for the supreme court of this State, in the case of Waterson *v.* Saldunbehere (101 Cal., 107), has decided that where there has been an actual appropriation and use of water a right to it is acquired regardless of compliance with the provisions of the civil code for the acquisition of water rights. Later, as the population increased and the inadequacy of the water supply to meet all demands became evident, many water users awoke to the desirability of placing upon the official records of the county written statements of their existing rights in order to protect their interests in the future. Thus it was that many of the earlier claims filed for record, being statements of established rights, endeavor to date back to an earlier period. In some instances reference is made with some degree of precision to a specified year, but more commonly open and notorious use of water for many years is asserted in broad and vague terms. Still later, the idea grew to secure almost general acceptance that the mere act of posting a written notice of claim was the only thing necessary to secure title to water, or, at the least, that it was so far the most important step as to overshadow all other requirements.

It may be safely stated that few of the recorded water claims bear evidence of having been prepared by an attorney at law, but the great majority make a serious attempt at legal formality and phraseology. A favorite phrase is to the effect that the claim is made "under and by virtue of the laws of the United States and of the State of California in such cases made and provided," whereas the remainder of the document itself is abundant proof that the claimant possessed not the slightest idea what those laws were. Another clause often found is the allegation that the claimant is "a natural-born citizen of the United States over the age of twenty-one." A volume could be filled with the superfluous and wholly irrelevant statements contained in notices which omit to mention the most essential facts.

LAWS OF APPROPRIATION.

Section 1415 of the civil code of California, enacted in 1873, provides as follows:

> A person desiring to appropriate water must post a notice, in writing, in a conspicuous place at the point of intended diversion, stating therein:
>
> (1) That he claims the water there flowing to the extent of (giving the number) inches, measured under a 4-inch pressure.[1]
>
> (2) The purpose for which he claims it and the place of intended use.
>
> (3) The means by which he intends to divert it and the size of the flume, ditch, pipe, or aqueduct in which he intends to divert it.
>
> A copy of the notice must, within ten days after it is posted, be recorded in the office of the recorder of the county in which it is posted.

The records show that as knowledge of these statutory requirements slowly spread among the people subsequent claimants endeavored either in good faith and to the best of their ability to comply therewith, or by perfunctory compliance with the letter of the law to evade its spirit. In consequence many absurd and preposterous claims have been perpetuated upon the record books.

The meaning of the term "to appropriate" has been generally misunderstood and continues so to this day. To a great majority of people "appropriation" and "claiming" are synonymous terms, and no language is more common in water notices than the statement that "I hereby appropriate the water," etc.

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[1] This unit of measure is regarded as equivalent to one-fiftieth of one cubic foot per second.

It is a matter of common knowledge that in general the posting of a notice at the place of intended diversion is farcical. Usually the posting is performed by attaching the paper to the rough bark of a convenient tree somewhere in the vicinity. Tacks or nails are not often provided, and substitutes are made of two or more twigs driven into knife punctures in the bark. Permanence of this notice is seldom deemed desirable and is less often secured. The wind may tear it from its insecure fastening a few minutes after being placed in position. If not destroyed bodily or blown away the first rain may blur or the sun may fade its writing to illegibility. But what matter? By posting the notice and recording a copy thereof within ten days the claimant has complied with the law and has no further concern. If the public or any individual suffers through the insufficiency or the ephemeral character of the notice, that is not to be regarded as the claimant's fault but as the other man's misfortune. In very many cases a suitable tree not being at hand the notice is not displayed to view in a conspicuous place at all but is folded, laid upon a bowlder or on the ground, and weighted down by a stone. It would require diligent search to bring to light all the notices which may be quietly reposing under stones in some of our mountain canyons.

The statute fails to require that the posted notice shall describe the geographical position of the place of intended diversion. However, probably a majority of the claims of record in Los Angeles County recognize the desirability of giving such information, and they attempt to furnish it. Unfortunately, in a vast number of cases, the description of locality is so vague and indefinite as to fail utterly in conveying any useful information. Usually the facts set forth with most particularity are those which are the most unnecessary, because perfectly obvious, viz, that the places are situated in Los Angeles County, Cal., and in many cases no more definite description is given. Numerous statements like the following are found: "I claim the water where I now stand," or "where this notice is posted on a tree," or "in this canyon." Following are a few quotations from recorded claims, and they constitute the only information contained in the several notices as to the localities:

> We, the undersigned, claim this water from this monument and ditch for 3 miles down this canyon.
>
> This water situated about 12 miles from the city of Los Angeles.
>
> Notice: The undersigned takes up this canyon and claims all this water running through this and to run, 24 inches more or less for agricultural and mining purposes, this notice being posted at both ends of said canyon.
>
> At a point above where the road crosses the stream and where the channel is depressed and the banks are steep and precipitous, being about 8 feet high, the right bank being covered with rocks and the left with trees.
>
> The water running in a north and south direction in this canyon.
>
> This notice is posted about 3 miles down the canyon from some three arastras run by steam power, and about 400 yards above an old stamp mill on the same canyon or creek.
>
> At this point, being a short distance above a large bowlder situated in the bed of the creek.
>
> This notice is posted on a tree just below the water in the canyon.

Many others of similar tenor are found. Frequently the only description is by reference to some obscure local name of a canyon, not shown upon any map, and known to a few residents of the immediate locality only.

The statute imposes no restriction upon the amount of water which may be claimed. In matters of this sort the virtue of self-denial is one seldom displayed.

On the contrary, the actuating principle evidently is to get as much as possible. Pursuing this policy, it is exceptional to find a notice which does not claim all the water of the stream, whether it be large or small. Frequently all this is amplified to embrace "All that is now flowing or that may flow at any future time;" "All that is above or below the surface;" "All the water in this canyon developed and undeveloped;" "All the water flowing or that can be made to flow;" "All the water flowing and that can be developed and diverted either by ditch, dam, well, or tunnel." One man makes this brief but forcible declaration: "I claim all the water rights of this creek." Where the claimant complies with the code provision requiring that the number of inches claimed shall be stated, it is customary to claim a practically impossible quantity. Large numbers are almost as easily written as small ones, and there is no extra cost for recording the notice. Hence no inducement exists for the claimant to exercise moderation in the statement of his claim. Many notices claim a specified number of inches, with the inconsistent qualification "more or less."

It is not at all suprising that a great many persons seeking to give a legal notice of their claims to water should stumble at such an incomprehensible unit of measure as the "inch measured under a 4-inch pressure." Many of their efforts to obey the law in this respect are ludicrous. One claims "all the water, amounting to 150 inches by hydraulic pressure of 4-feet measurement." Another notice reads, "The undersigned claim 4 feet of water from under a 4-inch pressure." Another, "to the extent of 100 square inches, miner's measurement." Still another, "100,000,000 cubic feet."

The provisions of the code show clearly the intent of the legislature, that before any person seeking to appropriate water can acquire any right therein he must have formed a definite plan of action so far perfected in detail as to enable him to set forth in his preliminary notice the more prominent features of his plan. Thus the law requires that the posted and recorded notice shall state the purpose for which water is claimed and the place of intended use, the means of diversion, and the size of the proposed conduit. Some of the smaller claims attempt to do this in good faith, but it is a more popular custom to evade these requirements by the broadest generalities. This is especially noticeable in the larger claims which are generally for speculative purposes. It is common to find notices claiming for all possible purposes which the ingenuity of the claimant can devise, and specifying nearly the whole of southern California as the place of intended use, that the diversion is to be accomplished by means of "headworks," and the water is to be conveyed by "conduits of sufficient size to carry the said amount." Sometimes the latter clause is expanded to include every form of conduit known to the claimant—for example: "By tunnels, cuts, earthen ditches; canals lined with masonry, concrete, stone, brick, or other materials; flumes of wood or metal; pipes of wood, steel, iron, cement, vitrified clay, or other substances; all to be of sufficient size for the purpose," or, "of such size as a competent hydraulic engineer may recommend."

Although the claimants are usually most liberal to themselves, wording their claims in phrases broad enough to cover all future contingencies, instances are numerous in which the notice shows that its author had no adequate conception of the quantity of water claimed or the carrying capacity of the specified conduit. One proposes to divert 200 inches by means of an iron pipe 2 inches in diameter for the first 40 feet, thence 1 inch to the place of intended use (a considerable distance away). Another claims "3,000 inches of water under a 4-inch pressure in this canyon and its branches, to be taken out in a pipe 1¼ inches in diameter." The performance of this feat would require the water to pass through the 1½-inch pipe at the rate of almost 1 mile a second, or about three times the velocity of a rifle bullet. Another claims 3,000 inches, "to be taken out in a ditch 15 inches wide and 10 inches deep." It would be interesting to know how long the ditch would endure the wear of such a destructive velocity as would be required. One prudent and farsighted man, after claiming a liberal flow of water and describing the ordinary means of diverting the same, provides for the emergencies of future dry years by adding, "I also claim the right to hand or pack from here to said ranch in case of drought or too little to run down."

From one cause or another the great mass of recorded notices wholly fail to perform the duty they were designed to fulfill. Probably the majority possess, or at one time have possessed, some value to the claimant, but they usually fail to give such notice to the public as the latter is entitled to expect when public property is sought to be taken for private use. If the claimant proceeds diligently and uninterruptedly with the construction of his works and actually appropriates the water as claimed in his notice, he is entitled to have the right thereby acquired date back to the time of posting the said notice. In this event it may be important, although by no means indispensable, to have an official record of the fact. Unfortunately it is the exception rather than the rule that a claim is ripened into an appropriation according to the terms of the notice or in the manner and within the time specified by law. In all such cases the recorded notice of claim is false and misleading, and with the lapse of time may acquire a force and standing to which it is in no wise entitled.

In California there is no officer authorized to scrutinize in any manner any water claim offered for record, nor whose duty it is to see whether the rights claimed by such notice are actually secured by the subsequent actions of the claimant, or whether they are allowed to expire by reason of his default. Vital questions touching prior rights to the water, the validity of the new claimant's preliminary notice, the good faith of his late proceedings, in fact the whole question as to whether an appropriation for a beneficial use has been made, and, if so, to what extent, are one and all left to be determined by litigation. Under our present law, or lack of law, on this point there is no other manner in which these questions can be decided. It is matter of common knowledge in this portion of the State that a lawsuit over water rights is the most protracted and costly form of litigation with which our courts are congested.

LITIGATION.

It was stated above that the city of Los Angeles has long asserted a claim to the entire flow of the Los Angeles River, basing its claim principally upon its succession to the peculiar rights alleged to have been granted to the old pueblo founded under Spanish law in 1781. It might have been expected that this supposed sole ownership would operate to prevent litigation. On the contrary, it has itself been the fruitful source of much costly litigation. Either as plaintiff or defendant the city of Los Angeles has been of necessity a party to most of the important suits involving Los Angeles River, and its "pueblo right" has been repeatedly on trial.

The first case to reach the supreme court of California in which "pueblo right" of the city was asserted is that of the City of Los Angeles *v.* Leon McL. Baldwin et al., January, 1879, reported in 53 Cal., 469.

In a previous action between the above-named parties the plaintiff city alleged that the pueblo of Los Angeles was entitled to and had claimed and used all the water of Los Angeles River ever since its founding, and that the city succeeded to all the rights of the pueblo. It further alleged that a certain ditch leading from the river into the city had been built by a third party and leased to the city, which was then using it to supply its inhabitants with water; that defendants, who were owners in the Los Feliz Rancho, riparian to the river, had diverted water from the ditch and threatened to continue doing so. Wherefore plaintiff asked for injunction and damages.

Defendants, in their answer, denied plaintiff's ownership of the river, or of the water flowing in the ditch, alleging that they themselves had built the ditch and granted it to the third party, from whom the city had leased it. They alleged that one of the conditions in the grant was that defendants should be entitled to use from the ditch all the water required for their rancho; that as riparian owners they were entitled to the reasonable use of the water of the river for irrigation and domestic purposes; that they and their grantors had continuously, since 1853, used the water flowing in the ditch to the extent of two "irrigation heads" (a head being about 100 inches), and that they had never used more than such reasonable amount.

The trial court found for the defendants substantially according to their answer, stating plainly that since the granting of the ranch in 1843 defendants and their predecessors had continuously claimed and exercised "adversely to plaintiff and the whole world" the right to use two irrigating heads of water from the river through the said ditch, and that the defendants had never used more than they were fairly entitled to as riparian proprietors. The court found, further, that at the time the action was begun there was a surplus of water in the river and in the ditch above what was needed for irrigation in the city, which surplus plaintiff was selling to consumers outside the city limits. There was no finding as to the right or title of the city in or to the water of the river.

The city did not appeal from this judgment, but after the lapse of some time brought another suit covering practically the same ground. The complaint in the second case alleged "that the plaintiff is and for a long time has been the owner of the waters of the river and is entitled to the full, free, and exclusive use of the waters of the river and the waters flowing in the ditches connected with the river, and has the right to regulate and control the use and distribution thereof."

The answer denies the exclusive right of the city to the waters of the river or ditches, and denies the right of the city to regulate and control the use and distribution of the waters. It alleges that the city has more water in the ditches than is needed for irrigation within the city, and that the surplus is being sold to parties outside the city. It also sets up in bar the former judgment.

The trial court found that the second action was substantially the same as the former one between the same parties, which had been decided in favor of defendants. It also found "that the plaintiff had shown no grant of the waters of the river other than such as inured to it from the fact that the river flowed through the lands of the pueblo and of the city." Also that surplus waters were being sold by the city to consumers outside the city.

Upon appeal by the city the supreme court decided:

(1) The claim set up by the city in this action—that the city is the owner of the corpus of the water in the Los Angeles River—finds no support in the evidence.

(2) Nor does the fact that the city is a lower riparian proprietor entitle her to judgment in her favor. The defendants are upper riparian proprietors on the same stream. In the former action between these parties it was adjudged that the diversion of the water by the defendants to the extent and in the manner in which they then diverted it was such as, being riparian proprietors, they might lawfully make. The conditions do not appear to be different now from what they then were. The diversion by the defendants is the same now as then, and while these conditions continue unchanged the judgment rendered in the former action operates as a bar between the parties here.

LOS ANGELES WATER COMPANY v. LOS ANGELES CITY.

The case of Los Angeles Water Company *v.* Los Angeles City was decided by the supreme court in April, 1880. It was reported in 55 Cal., 176. The city owned the Los Angeles waterworks, which it leased to the water company "for the sale or delivery of water to the inhabitants of said city for domestic purposes." One of the expressed conditions of the contract was to the effect that the water company should not dispose of any water for irrigation purposes, but should take from the river only such an amount as was necessary for domestic purposes. The city took water from the water company's pipes without its consent, and after a time the company sued to recover $2,500, the value of the water so taken.

The fact was established that at all times when water was taken from the company's pipes for street sprinkling the pipes contained more of the water of Los Angeles River than was required by the inhabitants of the city for domestic purposes. Judgment was rendered for the city. Upon appeal by the plaintiff, the supreme court held that under the contract between the parties the water company was not entitled to collect payment for water other than that furnished to the inhabitants of the city for domestic purposes; that the company had no right to the surplus, and that "water taken for the purpose of sprinkling the streets was water for irrigation within the primary definition of that word."

FELIZ v. CITY OF LOS ANGELES.

The pueblo right was again put upon trial in the case of Anastacio Feliz et al. *v.* The City of Los Angeles, decided by the supreme court in April, 1881, and reported in 58 Cal., 73. Plaintiffs claimed by riparian right and many years' continuous use, as did Baldwin in the original case noted above, but in this instance the city urged its peculiar and exclusive right to better effect and made out a much stronger case than in the earlier suit involving the same question. Inasmuch as the findings of the lower court are very comprehensive and contain the statement of facts necessary to an understanding of the decision, the following abstract is made therefrom:

(1) That in the year 1781, pursuant to the laws of Spain and the rules and regulations providing for the government of California, Los Angeles was duly formed into a pueblo, and became entitled to all the rights of a pueblo according to said laws, rules, and regulations, and all its rights as such pueblo since then were duly recognized and allowed by the Spanish and Mexican Governments during their respective occupation and control of the same, and also by the respective provincial and departmental authorities of California.

(2) That the river of Los Angeles rises several miles above the former pueblo of Los Angeles and runs down through said pueblo, and during the occupation and control of said pueblo by the Mexican Government the municipal authorities at all times exercised control of and claimed the exclusive right to use the waters of said river and all thereof, which right was duly recognized, acknowledged, and allowed by the owners of the land at the source and bordering on said river, including the grantors of the plaintiffs; and that ever since the occupation and control of said pueblo by the Government of the United States and that of the State of California the municipal authorities of what is now the city of Los Angeles have exercised the same control and claimed the same right in regard to the water of said river as was previously done by the authorities of said pueblo, except within the last two or three years, when the right of said city to said waters has been disputed by the plaintiffs and others, and a right claimed by them to use said waters; that the municipal authorities of said pueblo and city exercised control of said waters, and claimed the exclusive right to their use as aforesaid, for the purpose of irrigating the lands of said pueblo and city, and for domestic use of the inhabitants thereof.

* * * * * * *

(5) That the water of said river is necessary for the irrigation of the land within said city, and so confirmed as aforesaid, and also for the domestic use of its inhabitants, but until within the last two or three years all of said water has not been required in said city. For the last few years during the irrigating season, all of said waters, as they naturally flow in said river, have not been sufficient for the irrigation of the irrigable portion of said lands and the domestic use of said inhabitants; and said city, at an expense of more than $100,000, has constructed reservoirs to husband and save said waters for uses in said city; that a large portion of the irrigable lands of said city are not irrigated, and never have been irrigated, which will require more than all the waters of said river, with present facilities and resources of said city for husbanding and supplying the same. That said city has been supplying the inhabitants of said city with said water for uses aforesaid, and when there has been more than has been required for use in the city it has and still does sell to parties residing without, and to be used on lands without the city.

(6) That ever since about the year 1844 the plaintiffs and their grantors have owned, possessed, and cultivated the land claimed by them in their complaints, and have ever since irrigated the same from said river through the respective ditches maintained in the respective complaints, to wit: The Chavez and Feliz ditches, to about the same extent as now irrigated by the plaintiffs using the water, also for domestic purposes; and the waters of said river are necessary for the irrigation of said lands and for domestic use. But the uses of said waters were originally by permission and under consent from the municipal authorities of said pueblo, and have ever since been with such permission and consent, and not adversely nor claimed as of right until within the last three years, during which time (the last three years) plaintiffs have claimed, and still claim, the right to use said waters on their land and for domestic purposes.

(7) That plaintiffs are the respective owners of the parcels of land claimed by them in this complaint, and the respective ditches therein referred to are used and are necessary to irrigate the same; and said ditches have always been in the exclusive possession and control of said plaintiffs and their grantors from about the year 1844 until the 25th day of May, 1879.

(8) That on the 25th day of May, 1879, the plaintiffs were, respectively, and for several days prior thereto, diverting through said ditches, to the extent of about 100 square inches in each of said ditches, the waters of said river to and upon their respective tracts of land aforesaid, and using the same thereon for irrigation and domestic purposes, and the same was no more than was reasonable and necessary therefor. By reason of such use by plaintiffs water became diminished in said river, and sufficient thereof could not and did not reach said city or its waterworks (plaintiffs' said ditches having their points of diversion above said city and its waterworks) to supply what was reasonable and necessary for irrigation and domestic use in said city; and by reason of such diversion by plaintiffs a number of the inhabitants of said city were deprived of what was reasonable and necessary for the irrigation of their land in said city, and for their domestic purposes; and the defendant city lost on its sale of said waters more than $50 on account of the diversion in each of said ditches, respectively. Whereupon, on that day, and in order to supply the inhabitants and land of said city with sufficient water for said purposes, and in order to regulate and control the distribution of said waters in the most beneficial and regular manner, the said city, by its officers and agents, entered upon said ditches at their respective heads and returned the water therein to said river and placed therein headgates.

The findings of the court, as above quoted, seem to support the city's contention in every respect. It is, therefore, most surprising to read that judgment was given for the plaintiffs. It was to the effect that, being riparian owners, the plaintiffs were entitled to divert a reasonable amount of water from the river for irrigation and domestic use. The decree perpetually enjoined the city from interfering with the ditches or with the plaintiffs' use, upon their said land, of a reasonable quantity of the river water for irrigation and domestic purposes. This decision of the lower court can only be regarded as evidence of the peculiar sanctity with which riparian rights are clothed in nearly all courts. Here almost every ascertained fact was against the applicability of the English common law; nevertheless judgment was rendered in favor of perpetuating that doctrine in a region where its use is an absurdity.

The city appealed. In its decision the supreme court quotes at length from the findings of the lower court, noting the facts that for a century the city claimed *all* the waters of the river, and that "such claim had been recognized by all persons interested, from the head of the stream and along its banks, including the plaintiffs." The decision of the lower court is reversed and judgment ordered for defendant upon the findings.

The supreme court says that it did not examine the rights of the city "under the Spanish and Mexican laws applicable to pueblos, for the findings in the case render such examination unnecessary," but it goes on record touching one branch of the city's asserted right as follows:

> We do not intend to be understood as holding, nor do we hold, that the city has the right at any time to dispose of the water for use upon lands situated without the limits, to the injury of the plaintiffs or other owners of land bordering on the river. On the contrary, we are of the opinion that the city has not that right. But as already observed, the findings in this case show that at the time of the acts complained of there was not sufficient water in the river for the needs of the inhabitants of the city; and we hold that, to the extent of the needs of the inhabitants, it has the paramount right to the use of the waters of the river, and the further right, long exercised and recognized, as appears from the findings, to manage and control the said waters for those purposes.

ELMS v. CITY OF LOS ANGELES.

The case of Henry Elms et al. *v.* The City of Los Angeles, reported in 58 Cal., 80, was another case involving the city's pueblo right. The facts and the arguments were the same as in the preceding case, and the judgment of the lower court in favor of the plaintiff was likewise reversed by the supreme court on appeal.

VERNON IRRIGATION COMPANY v. CITY OF LOS ANGELES.

The pueblo right claimed by the city is once more the principal issue in the case of The Vernon Irrigation Company *v.* The City of Los Angeles et al., decided by the supreme court in March, 1895, and reported in 106 Cal., 237. The plaintiff corporation, the owner of lands riparian to Los Angeles River, alleges that it is entitled to have the waters of the river flow in their accustomed place, and sues for an injunction to prevent the city from diverting them. The plaintiff further alleges that the city has no right to the river waters except "the right to divert and use a certain quantity, which it has been using, for municipal purposes and distributing to its inhabitants, which does not exceed 300 inches;" that the city threatens to enlarge its ditches so as to divert the entire flow of the river for the purpose of selling the same outside the city limits; that plaintiff owns a water right, acquired by appropriation, to divert from the river 2,100 inches.

The answer of the city denies plaintiff's rights and claims all the water of the river:

> (1) As successor of the pueblo of Los Angeles, which it contends owned all the water in the river. (2) As an appropriator of the water, claiming that it has been in the undisturbed and undisputed use of it, under claim of right, for fifty years.

A full statement of the facts is contained in the opinion of the supreme court, which is voluminous, covering nearly twenty pages of the report. The opinion also quotes at length from the findings of the lower court and abstracts from briefs of counsel much interesting history of the organization and administration of the pueblo under Spanish and Mexican laws. Following is a brief outline of portions touching the subject of our inquiry:

> The waters of all rivers were, under the Spanish and Mexican rule, public property, to be administered and distributed for the use of the inhabitants. Apparently this was sometimes done by the pueblo authorities outside of the pueblo lands. * * * When the pueblo was organized under the laws a sufficiency of this water was appropriated to it. * * * The pueblo had a prior right to consume the waters, even as against the upper riparian proprietor. * * * The court approves the decision of the supreme court in Lux *v.* Haggin (69 Cal., 255), to the effect that the right of the city as successor to the pueblo to the water, for its inhabitants and for municipal purposes, is superior to the rights of plaintiffs as a riparian owner. Approval is also given to the decision of the court in Feliz *v.* City of Los Angeles, above noted, that the city has no right to take from the river more water than is required for its inhabitants and for municipal purposes and to sell the same outside the city. * * * Pueblo had preferred right to the water, but only to the amount needed for its inhabitants. * * * The city's claim that it has acquired a right by appropriation of fifty years' standing to sell surplus water outside its limits is denied by the court on the ground that under its charter the city had no power to do this, and hence that it could secure no such right by the unauthorized acts of its officers. This right may have existed at one time, but subsequent limitations in the city's charter amounted to an abandonment thereof.

CITY OF LOS ANGELES v. POMEROY ET AL.

The pueblo right was again tested in the case of City of Los Angeles *v.* Pomeroy et al., reported in 124 Cal., 597, and 57 Pac. Rep., 585. This suit was begun in June, 1893, came to trial in March, 1896, and was decided in the superior court in June, 1899. It is a case of colossal dimensions. A large number of engineering expert witnesses were introduced on both sides. The transcript on appeal is a voluminous document, and the opinion of the court covers nearly fifty pages of the report.

Defendants were the owners of a large tract of land situated in the southern portion of the San Fernando Valley, near its outlet, and at a point where the valley has narrowed to a width of 2 to 3 miles. The city sought to condemn all the right, title, and interest of defendants in a portion of the said tract containing about 315 acres. This land, comprising a strip about 2 miles long by one-fourth mile wide and traversed by the river throughout its length, was wanted for the purpose of constructing suitable headworks for the proposed extension of the city's waterworks. Defendants claimed that the land sought to be condemned contained an enormous quantity of percolating water capable of development, upon which they put a high valuation, which they claimed ought to be paid them if their land was taken for public use.

The main issue involved in the case is complicated with a large number of subordinate questions, the decision of the supreme court embracing twenty-five distinct points. Most of them, however, relate to legal technicalities, and two questions only are prominent in the controversy. These are—

(1) As to the existence of a well-defined subterranean stream by which the waters, or a large portion of the waters, resulting from the rainfall within the watershed of the San Fernando Valley, are carried off through the pass between the Cahuenga Range and the Verduga hills; and, (2) as to the rights of the city of Los Angeles, as successor to the Mexican pueblo in the Los Angeles River.

Regarding these two points the city alleges that it has certain rights in the river superior to those of ordinary riparian proprietors; that the river is composed of the surface stream and a large subterranean stream moving through the sand, gravel, and bowlders under and adjacent to the river; "that ever since its organization the city has been the owner in fee simple of the exclusive right to the use of all the waters in said river from its source to the southern boundary of the city, in trust, for the public purposes of supplying the inhabitants of said city with water for domestic uses, and of supplying water for the irrigable lands embraced in the 4 square leagues of the pueblo, and for other municipal uses;" also that the defendants own their land subject to the right of the city in the Los Angeles River.

Omitting such points of the decision as relate to legal technicalities, the following are quoted from the syllabus:

Percolating water—Subterranean flow of river—Value of land.—Percolating water which forms part of the subterranean flow of Los Angeles River, and is moving in the same direction with it, through the lands sought to be condemned, does not belong to the owner of the soil, and can not be taken and conveyed away by him to other lands for sale; and where the supply of the percolating water which might be so removed is of slight value, and might be wholly interfered with by drainage on adjoining lands, a verdict fixing the value of the land at its market value for agricultural purposes will not be disturbed upon appeal.

Percolation not inconsistent with stream—Defined channel.—The fact of percolation is not inconsistent with the idea of a stream, when it is caused by the waters of a subterranean stream passing through the voids of loose, permeable material, or partially obstructing the channel of the stream, and when the material through which the water forces itself fills a well-defined channel with impervious sides and bed.

Diversion of underflow or percolating water.—The owner of the soil can not divert any part of the underflow of (or?) subterranean water forming part of the stream, whether such water would or would not reach the surface stream of the river; nor can he divert percolating water if the effect would be to cause the water of the stream to leave its bed to fill the void caused by such diversion.

Nature of subterranean stream—Question of law.—What a subterranean stream must be in order to bring it within the law of riparian rights is a question of law. * * *

"Defined" and "known" channel—Reasonable inference.—The channel of a subterranean stream is "defined" when it is contracted and bounded, though the course of the stream may be undefined to human knowledge; and its course is sufficiently "known" when it is the subject of reasonable inference.

Inference as to channel—Submission to jury.—Where the boundaries of the channel and the existence and course of a subterranean stream in the lands sought to be condemned are not defined or known otherwise than by inference from the evidence, and it might reasonably be inferred therefrom that the channel was bounded and defined by the sloping sides of hills meeting underground, and that there was a subsurface flow in the channel through such lands, corresponding with the known surface flow of the river outward through the gap, the court was justified in submitting to the jury whether the subsurface flow in such lands was a part of the stream.

Extent of paramount rights of city—Riparian rights of Mexican grantees.—The paramount rights of the city of Los Angeles in the waters of Los Angeles River over the riparian rights of persons claiming under Spanish and Mexican grants are not limited to water sufficient to supply the original pueblo, to which the city was a successor; but the extension of its limits by increase of the population must be deemed within the purview of the original grant of those waters to the pueblo, and the effect of the grant must be deemed the same as if the waters had been condemned for public use, and all possibilities of the future growth and requirements of the city were taken into consideration.

Outfall sewer.—The water having been granted or dedicated for the health and convenience of the pueblo, as well as for other purposes, the right to drain the city by means of an outfall sewer, and to keep it in a state of efficiency by the necessary flushing, is within the pueblo right.

Ponds and artificial lakes—Discretion of city.—The needs of the city may extend to the use of water for ponds and artificial lakes; and the discretion of the municipal authorities in such use will not be interfered with where no gross abuse of such discretion is manifest.

Suspension of ayuntamiento.—The suspension of the ayuntamiento (town council) of Los Angeles under the Mexican law of 1837, and the temporary administration of its affairs by a prefect, did not affect the paramount rights of the pueblo to the use of the waters of Los Angeles River.

The pueblo right of the city of Los Angeles to the water of the Los Angeles River may now be fairly regarded as firmly established, although the question has never yet been taken to the Supreme Court of the United States, and of course until it is finally decided by the court of last resort the possibility of its overthrow will always exist. According to the supreme court of California the city, as successor to the Spanish pueblo, has a paramount right to all waters of Los Angeles River, whether on or beneath the surface, to the extent of the needs of the inhabitants for irrigation and domestic purposes, and of the city for municipal use; this right is not limited to the amount actually used by the pueblo, nor to the particular purposes for which water was formerly applied, but the right is an elastic one, growing as the city grows, and capable of being extended to include every use to which water may properly be applied by a modern municipal government. The rapid growth of the city, from 11,000 in 1880 to 50,000 in 1890, and 103,000 in 1900, a growth of more than 100 per cent in the last decade, has led the city, in recent years, to guard with jealous care its water supply so as to provide for future growth. The city's right to Los Angeles River being well established, the only question remaining is, What is the river? Attempts to determine this question have produced several lawsuits of enormous dimensions and corresponding cost. One of the greatest of these, the case of The City of Los Angeles *v.* Crystal Springs Land and Water Company, is still pending. It was begun in 1891 and has not yet reached the supreme court. The defendant, a corporation closely affiliated with the Los Angeles Water Company, laid pipes with open joints designed to admit water, in close proximity to the river, claiming that the flow secured thereby was water developed from percolations in their own land. The city claimed that the developed water was part of Los Angeles River. A large number of hydraulic engineers were introduced as expert witnesses by both sides.

The city has had much costly litigation with the Los Angeles Water Company, to whom the city's waterworks were leased in 1868 for a term of thirty years. In these suits the questions have not related to title to the river water, but have turned upon construction of the contract, the method of appraising value of the company's property which the city desired to purchase, the validity of arbitrators' award, etc.

THE CITY OF LOS ANGELES v. WEST LOS ANGELES WATER COMPANY.

Another important case involving the distinction between a supposed subterranean stream, claimed to be a part of the river, and percolating water, which would be considered part of the land, and therefore the property of the owners of the land, is that bearing the above title.

The West Los Angeles Water Company is the owner of a large tract of land situated in the San Fernando Valley, at some distance from the visible Los Angeles River. Operating on its own land, the company constructed a number of open cuts and tunnels containing wooden flumes or galleries open at the bottoms for the admission of water, and in this manner has developed a flow amounting to several hundred inches of water. The city again asserts its "pueblo right" in the fullest and most explicit terms, and alleges that in 1895 defendants entered upon the line of various branches of Los Angeles River, both surface and subterranean, and without right or authority excavated certain trenches, ditches, and tunnels whereby not less than 400 inches of water were diverted and the natural flow in the river diminished by that amount. The defendant claims that the water is developed from percolations in the soil, not a part of the river. The suit was begun in May, 1897, and is now set for trial in November, 1900.

DISTRIBUTION AND USE OF WATER.

The supply of water for irrigation in Los Angeles is distributed by means of an extensive and intricate system of zanjas, maintained and administered by a department of the city government. Regulations governing the distribution are prescribed by ordinances of the city council. The executive officer is a water overseer, who has a chief deputy and two outside deputies commonly known as "zanjeros." During the summer season, from April 1 to November 1, the number of field deputies is increased to five.

On the 24th or 25th days of the month each irrigator who desires water during the ensuing month must file an application therefor, filling in a blank form provided by the city. This application contains the name of the irrigator, number of the ditch from which the supply is to be drawn, number of "heads" of "day water" or "night water" desired, and the dates when wanted. Sunrise and sunset divide the twenty-four hours into day and night runs. The basis of distribution fixed by the city council is one irrigation head for twenty-four hours' run every month for 10 acres of land. The "head" is an imaginary unit whose value has never been determined. For the sake of convenience it is usually estimated as amounting to 100 inches, but as a matter of fact it ranges in value from less than 50 inches to more than 150 inches, according to the available flow of the river.

The number of "heads" of water ordered for a month must be paid for in advance not later than the 30th day of the preceding month. In acknowledgement of such payment a receipt is given in the following form:

DAY.

WATER OVERSEER'S OFFICE,
Los Angeles, Cal., ——— —, *1900.*

From Sun to Sun.

Received from ——— ——— the sum of four dollars for the use of zanja No. —— for the purpose of carrying one head of water through the same for one day only.

——— —, 1900.

——— ———, *Water Overseer.*
——— ———, *Deputy.*

The rate per half day is $2.50. A receipt in the same terms, but printed on paper of a distinguishing color, substituting night for day, and at the rate of $2 instead of $4, is issued for night runs.

Notwithstanding the decision of the supreme court that the city has no authority to sell water outside its limits this is still being done to some extent. This custom is not maintained in defiance of the courts, but simply because it is a physical impossibility to yield exact obedience to the court's decisions. Occasions sometimes arise when there are odd hours or fractions of days not covered by applications of irrigators within the city. At such times the surplus water ought not to be diverted from the river by the city, but it should be allowed to flow down the natural channel of the river for the benefit of riparian owners. This is obviously impossible under the circumstances. The zanjas are many miles in extent and hours are required for the passage of water from headgates to the consumers. The attempt to perfectly regulate at the headgates the flow in each ditch would lead to the utmost confusion and result in much loss of water. Moreover, small quantities of water allowed to flow down the river bed at wide intervals of time would accomplish no good whatever, but would be wholly lost. Under these conditions, therefore, it is the practice to allow the surplus water to run through the zanjas to the lower limits of the city, there to be taken and used by outsiders.

Although the process of supplying irrigators is usually termed "selling water," it will be seen from the above form of receipt that it is technically the use of the ditch which is sold or rented. The rate charged outsiders is $5 and $2.50 per "head" for day and night, respectively. It will be noted also that the city does not undertake to supply a definite quantity of water, nor does it assume any responsibility whatsoever. The irrigator does not acquire a permanent right to the use of water; he simply rents from month to month the use of the ditch to convey his pro rata share of the available supply, taking his chances against losses by breaks or thefts. New land is entitled to the same consideration as that which has been using water for many years.

The growth of the city has been remarkably rapid. As the built-up portions have extended over the farming lands, the amount of water taken from the pressure system of the city for domestic purposes has increased correspondingly, while the demand for irrigation is said to have been kept about the same from year to year by successive extensions of the city boundaries. The result has been a demand upon the river greater than ever before, and greater than it is capable of meeting under existing conditions.

The methods of distributing irrigation water practiced by the city of Los Angeles are astonishingly crude and unsatisfactory. It would be impossible to find another system in California—in the southern portion at least, and probably not elsewhere in the State—where such unscientific means are still employed. The practice is simply the survival of the old-time careless Mexican method, little if any improved by lapse of time. Given an unknown quantity of water in a ditch, comprising a certain number of "heads," one "head" to serve 10 acres for twenty-four hours each month; required, the pro rata to be delivered to 3½ acres, 22 acres, 8½, 16, 1,120, 80, 27, 30, 9 —— etc., acres, respectively. It would seem that the solution of problems as important as these should be attacked by some more scientific method than the guessing ability of the "zanjeros."

The foregoing is not to be regarded as reflecting upon the water overseer's force. Their duties are performed according to instructions from the city council. The maintenance of this inefficient system is due apparently to the indifference or conservatism of the municipal legislative body, and perhaps in the past to the city's desire to monopolize the flow of the river in order to prevent the possible establishment of adverse rights. In the latter case the practice has proved to be a boomerang, and, whatever the cause, it is needlessly wasteful. For some years the river's supply has been inadequate to meet the increasing demand. In the summer of this year, 1900, the third consecutive year of drought, the shortage became so serious that the city was driven, hurriedly and at considerable cost, to construct three pumping plants with a view to augmenting the irrigation supply from the large underflow supposed to exist below the dry bed of the river, but these are stated to have been largely disappointing.

Where the methods of measurement are so primitive it is natural that the irrigation practice should be correspondingly crude. It is so in and about Los Angeles where the duty of water is very low. There can be little doubt that by a modern system of measurement and apportionment the water now available would be found capable of a vastly greater duty, the income from the sales of water would be increased, pumping could be dispensed with, and the necessity of largely supplementing the supply would be postponed some years.

The West Los Angeles Water Company is elsewhere mentioned as involved in litigation with the city over its right to develop on its own land percolating waters, which, presumably, would ultimately reach the river if not intercepted. For five years past this company has taken from the San Fernando Valley a quantity of water ranging from about 500 inches to about one-half that amount, which it has sold for irrigation and domestic use in the western portion of the city and in the fertile Cahuenga Valley, its system extending to the Soldiers' Home, near Santa Monica. In the beginning the company sold acre water rights equivalent to 1 inch of water to 10 acres of land. These were sold for $40 per acre, and in addition an annual rental of $8 per acre, payable quarterly was provided for. After 225 of these acre rights had been sold the company discontinued their sale, preferring not to obligate itself in this manner, but rather to reserve its supply to meet the rapidly growing demand for domestic service. Its present method of selling water for irrigation is termed "gallon sales," and is at the rate of 10 cents per thousand gallons. The form of agreement covering this transaction imposes no liability upon the company; it provides for the sale of surplus water only, and does not secure to the purchaser the right to the same or any supply of water in the future. Where water is sold for mixed irrigation and domestic use, there is a minimum rate of $1.50 per month. This rate entitles the consumer to 6,000 gallons; any excess above this amount is charged for at the rate of 10 cents per thousand gallons.

The rates established by the company are by statute subject to revision by representatives of the people. Inside the city limits the city council has authority to fix rates, and outside the city the board of supervisors of the county has this power.

This company considers itself the absolute owner of the water handled by it. In this respect it is in a different position from companies dealing with natural streams. If its contention in the pending litigation with the city is correct, viz, that its supply is developed from waters percolating in the soil—hence a part of the soil—owned by it, there is no doubt that under the existing law the water is as much the subject of absolute ownership as the same quantity of sand or clay or stone taken from the same land would be.

Under the West Los Angeles Water Company's system water is carefully measured and the consumer pays according to the amount used. Hence there is an incentive to economy, and the duty of water will be found to be much greater than under the city's wasteful system.

It may be remarked in closing that generally throughout southern California all water, even that diverted from natural surface streams, is practically regarded as subject to absolute ownership—that is to say, the water is not attached to the land. It may be bought, sold, or rented like any other class of merchandise. It may be owned by a person who has not a square foot of land; it may be transferred at will from one tract to another, etc. In fact, the only apparent difference between the present accepted title to water, and the absolute ownership thereof seems to be that a prescriptive title to water may be acquired by five years' adverse use. But it is hardly necessary to add that at the present time no water will be found running around loose in southern California without an owner. The usual trouble is that there are too many claimants.

CONCLUSIONS.

Having noted in the foregoing pages some of the shortcomings and abuses of the existing system of acquiring and administering water rights in this vicinity, it may be proper to add some suggestions as to how this system may be improved.

When we remember the paramount importance of irrigation in southern California, it may seem strange that a more rational and systematic plan of treatment was not adopted long ago. That it was not is due probably to the unfriendly attitude shown by a majority in the State legislature toward irrigation. Until quite recent years the people living in the greater part of the State regarded irrigation in the same light that eastern people generally view it, viz, that it is a grievous hardship imposed by nature upon the inhabitants of certain ill-favored regions of the earth. Holding this opinion it was the custom of the central and northern counties to depreciate the advantages and to magnify the disadvantages of irrigation. Through their newspapers and by all other means of publicity they sought to advertise the fact that by great good fortune irrigation was unnecessary in their respective localities, and they endeavored by these means to attract immigration to themselves. Those sections where irrigation was properly understood were always represented by a minority in the legislature. Under these circumstances it is not surprising that the irrigation interest failed to secure due recognition and to have established a code of laws under which it could develop in a safe and permanent manner.

At no time in the past has a thorough study of existing conditions and needs been made. Statutes have been framed without full knowledge of the magnitude of the subject and its economic importance to the State. The law as laid down by decisions of the supreme court has been largely in the nature of attempts to harmonize with the peculiar conditions of the arid region the unsuitable rules of the common law transplanted from lands where irrigation is unknown.

PRESENT WATER LAW DERIVED FROM MINING LAW.

The law governing mining claims is undoubtedly the parent of the statutory procedure for the establishment of a water right. The former requires the posting of a notice at the point of discovery and the recording of a copy in the office of the recorder of the mining district; the latter requires the posting of a notice at the point of intended diversion and the recording of a copy in the office of the county recorder. Both require that actual work upon the development of the claim shall be commenced within a specified time, but here the similarity ends, and the subsequent working of the mining law is far more effective than that of the water law. The former requires a definite description of the locality affected by the claim; the latter does not. There may be many mining districts in a county thus keeping the records near the locality interested, but there is only one county recorder's office however large the county may be. The mining claimant is compelled to make proof annually of the amount of development work performed, or to secure title by patent, but the water claimant leaves no record as to how much—if anything at all—he has done toward the consummation of the appropriation set forth in his original notice.

IMPROVED SYSTEM OF MAKING APPROPRIATIONS NEEDED.

The act of posting a notice in some thicket or under a bowlder in some obscure mountain canyon is a very crude way of beginning so important a work as an appropriation of water, nor is it much improved by sending a copy to the county recorder's office to go on record among many thousands of similar claims. Under a rational irrigation law several items of information are indispensable before initiating a new appropriation of water. This knowledge should be supplied to the intending appropriator by the only competent authority—the State. The principal points required are:

(1) What prior rights exist upon the available sources of water; their nature and extent.

(2) What quantity of water remains subject to appropriation.

(3) What quantity the claimant will be permitted to take for the intended use.

After formal notice has been given of an intention to take a portion of the public water supply for private use, the public should have the right to supervise the claimant's actions in the matter and to hold him to a faithful performance of the duties and obligations assumed by him.

All agree that the California water laws now in force are seriously deficient, and that they must be reformed. The only question is as to what old and new features are desirable to be embraced in the new law.

In the opinion of the writer no plan yet suggested promises results at all comparable with those which would be derived from the creation of a scheme of State administration following the general lines of the Wyoming board of control. That State is divided into four water divisions bounded by natural hydrographic lines. Each division has a superintendent, and the four superintendents, together with the State engineer, compose the board of control. This board is vested with authority to adjudicate existing water rights. For this purpose meetings are held in various portions of the State at places where the rights under examination are located. The State engineer measures the streams and ditches, and the board secures an intimate knowledge of the facts and conditions before a decision is rendered. The whole procedure is as simple and effective as can be conceived, and it produces a minimum of annoyance and expense to those concerned. The work of this board for the past ten years has had the effect of practically abolishing the exhaustive litigation over water rights which is so common in other States. The State engineer and the division superintendents are also charged with the duties of ascertaining the water supply, apportioning it among the consumers according to their respective rights, issuing permits for new appropriations, keeping complete records of all the diversions on the different streams of the State, etc. The plan has given unqualified satisfaction to the people of Wyoming, and it promises equal success in California.

WATER RIGHTS SHOULD ATTACH TO THE LAND.

In southern California it has been the general practice for many years to treat the right to use water as equivalent to the absolute ownership of the water. This view is not affirmed by decisions of the supreme court of the State. On the contrary, the attitude of the court is adverse to the principle of private ownership of the corpus of the water.

The propriety of having all water rights attached to the land itself is so manifest that it seems evident that the reformed code of irrigation laws for this State will contain a declaration to this effect.

Doubtless it is within the power of the State to declare that existing water rights, as well as those hereafter established, must be appurtenant to the land, and it seems that such practice will be just and equitable to all concerned.

WASTEFUL PRACTICE SHOULD NOT BE PERMITTED.

The irrigation practice on Los Angeles River is peculiar in many respects, due to the fact that the whole flow of the river is claimed by the city of Los Angeles, but it is like that of all other localities in showing the necessity for intelligent supervision by some authority other than that of the principal claimant. Los Angeles is notoriously prodigal in its use of water for domestic and ordinary municipal purposes. Therefore it is not surprising that it should be lavish with its irrigation supply.

The trait of human nature which leads the average purchaser of any valuable commodity to get all that he can for his money finds full sway in the city's management of the water supply. There is no incentive to economy. Elsewhere there is a general recognition of the principle that the only equitable basis for water rates, whether for irrigation or other use, is to charge according to the amount of water actually taken by the consumer. Where the charge for irrigation is made by the acre each consumer will probably take all that he can get, the cost being the same. Were the city to provide a modern system of distribution by accurate measurement, charging according to the quantity taken, a decided improvement in the line of economy of water, with corresponding increase of area served, would soon result. An officer of the State should see that the city, and those who receive water from the city, should not divert from the river a greater quantity of water than they can use in a reasonable manner for beneficial purposes.

The drought which has prevailed throughout southern California for the past few years has been a blessing in disguise in more than one respect. It has caused the search for underground water which has been so notably successful in many localities, and, still more important, it has taught to thousands of irrigators needed lessons in the economical use of water. There is no danger of anybody using too much water for irrigation when he has to pay the cost of raising it from deep wells. The same consideration for his pocket will prevent the average irrigator from applying too much water, or wasting it in any manner, when he has to pay in strict proportion to the amount of water delivered to him.

Notwithstanding its antiquity, the irrigation practice on Los Angeles River, like that of other sections of the State, in order to secure the best possible results from its water supply and to bring forth the greatest good to the greatest number, needs the supervision of an able and impartial State officer.

RECOMMENDATIONS.

(1) A board of water control should be created for the purpose of ascertaining existing water rights and supervising the acquisition of rights in the future; said board to consist of three members, all of them irrigation experts, to be appointed by the supreme court, and to hold office during good behavior; sessions of the board for the adjudication of water rights to be held as near as practicable to the respective localities affected. Appeals should be allowed from the decisions of the board to the supreme court.

(2) The court should select as one of the members of the board of water control an able hydraulic engineer, to be known as the State engineer, and who shall be the executive officer of the board in the administration of its duties.

(3) Riparian rights should be made subordinate in all respects to rights of appropriation.

(4) All unappropriated waters should be declared public property, the statute providing means whereby the right to use the same for private purposes may be acquired by appropriation; such right to become attached to the land irrigated or to the other use for which the water is appropriated, and limited to the actual necessities of such use.

(5) There should be cooperation and consultation between the State and National governments looking to the fullest possible use of the waters of the State for irrigation, with special reference to the Sacramento, San Joaquin, and Colorado rivers.

(6) Definition of the work to be done by the National Government as distinguished from the sphere of State activity; the former to include protection and extension of the forests, the investigation of better methods of irrigation now being carried on by the U. S. Department of Agriculture, the hydrographic surveys of the U. S. Geological Survey, and the storage of waters for public lands.

(7) The right of eminent domain should be extended to include the taking of lands or rights of way for canals and other works necessary for the development, conservation, and distribution of water, and the taking of vested water rights for the superior right of domestic use, whether such taking be for public or private benefit.

(8) The board of water control should be vested with the authority to fix water rates now possessed by county supervisors, city councils, or boards of trustees of municipalities.

(9) The supreme court of California should be requested to appoint an expert nonpartisan commission to frame an irrigation law suitable to the needs of the State and embracing the principles above outlined.

REMARKS ON THE FOREGOING RECOMMENDATIONS.

The provision that the members of the proposed tribunal be appointed by the supreme court will inspire public confidence that they will be as far removed from political or other undesirable influence as it is possible to have them.

A statement that decisions of this tribunal shall be "final" will doubtless arouse much opposition. The right of appeal should be preserved, and it should lie direct to the supreme court. There is no reason why a claim adjudicated by this tribunal should be subject to review by any except the court of last resort; nor should attorneys be admitted to practice before this tribunal. To permit these things is to perpetuate the present system of endless and exhaustive litigation.

Owing to the unfortunate history of the former State engineer's department and the present growing hostility to the continued multiplication of bureaus, commissions, etc., in this State, strong opposition to the creation of this organization is apprehended. Nevertheless, it is essential to the plan and should be urged strenuously.

The complete subordination of riparian to appropriative rights will probably secure the desired end as well as the abolition of the former.

It would seem that it is still within the power of the people to declare that an existing water right should become attached to the land whereon it is now used. If so, this should be done, as it will be cumbersome and inconvenient to have two general classes of rights, the one fixed and the other movable at will.

Navigation and irrigation along the rivers of arid America are as incompatible as riparian rights and rights by appropriation. Speaking generally, there is far more arable land in the arid region than can be watered from any source whatever. The greatest good to the greatest number of people will be secured from these streams when their navigation is rendered impossible by reason of the consumption of water by irrigation. The amount of water required to maintain navigation, even in a canal or canalized river, is enormous, and the benefit derived by the public from its use in this manner is vastly less than would follow from its use for irrigation. There is no "divine right" of navigation. The fact that this industry has long enjoyed special privileges and the paternal care of governments to whom irrigation is unknown is no reason why it should continue to be so nurtured in a region where the waters of rivers are needed for a more beneficial purpose. There is probably no river navigation which does not constantly, or at least frequently, require liberal State or national aid in order to maintain its existence. Withdraw this artificial stimulus and rapid decline will follow. Were notice to be given now to the inland navigation interests of California that henceforth no further financial aid will be given them, but that, on the contrary, it will be the policy of State and nation to encourage to the fullest extent the use of such streams for irrigation, such action would prevent further expansion of navigation and make it feasible to purchase or condemn existing rights whenever such a course may be found desirable. To attempt the maintenance of navigation on any stream in arid America by means of impounded water would be a waste well-nigh criminal. The use of waste and seepage waters for this purpose is a very different matter. Possibly such a plan may be practicable on the Sacramento and San Joaquin rivers, but where the water of a navigable river can be consumed in irrigation it will be far more profitable to the State and nation to so use it, even if the benefits derived by the people from inland navigation had to be preserved by the substitution of a State railway for the waterway.

I have found difficulty in deciding whether the Wyoming plan of board of control might not be applicable to our conditions, but in view of the large number of water claims now existing and which would require early adjudication, I have concluded that a somewhat different organization is desirable.

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PROBLEMS OF WATER STORAGE ON TORRENTIAL STREAMS OF SOUTHERN CALIFORNIA AS TYPIFIED BY SWEETWATER AND SAN JACINTO RIVERS.

By JAMES D. SCHUYLER,
Hydraulic Engineer.

INTRODUCTION.

Sweetwater and San Jacinto rivers have been selected for the study of water-right conditions and general storage and irrigation problems, because on each of these streams substantial masonry dams have been erected, and the storage of water and its distribution for irrigation and general domestic service have been established for a period sufficiently long to afford valuable experience and precedents. The writer has been selected to make a study and presentation of these problems and experiences, presumably because he was the engineer who designed and built the dams on both streams.

Aside from the Bear Valley Dam on the headwaters of Santa Ana River and the Cuyamaca Dam on the headwaters of San Diego River, the Sweetwater and Hemet dams are the only completed structures in southern California that impound, utilize, divert, and distribute water from torrential streams. A number of other dams have been projected, and several have been partially or wholly completed, but are not as yet in service.

There is a peculiar interest attached to the storage reservoir and distributing system which derives its supply from a torrential stream, as it is a creation of something of permanent value out of that which would not only be otherwise wasted and lost, but would frequently cause havoc and destruction to property in the act of going to waste. As its name implies, the torrential stream is one of violent force and action during certain intermittent periods of its career, and its power and capacity for destruction everywhere need to be curbed. Not the least useful of the functions of the impounding reservoir, therefore, is that of lessening the destructive force of the torrent upon which it is situated. It is doubtful, however, if such substantial and costly works as are needed for effecting this purpose would be undertaken by any community for that object alone, and unless the water impounded can be put to use, and either harnessed for power or consumed in irrigation, or both, and is obtainable free from legal complications or harassing restrictions, the incentive will always be lacking for the construction of such permanent dams, either by individuals, private corporations, or municipalities. Every possible encouragement needs to be afforded for such enterprises in the way of smoothing the legal paths; and the purpose of this inquiry, as I understand it, is to ascertain what the experience of years in the actual impounding and use of water on these streams has been, physically and legally, and what modifications of the laws appear to be desirable in the light of these experiences, in order that it may become easier to utilize the public streams and the water going to waste. The obstacles which nature places in the way of executing such works are quite sufficient without having to overcome legal barriers and restrictions of a burdensome nature. These natural obstacles are such as to restrict the number of enterprises which are practicable from an engineering standpoint to a very few, and consist chiefly in a lack of a satisfactory combination of conditions essential to success. These requisite conditions are, briefly stated:

First. A dam site, preferably in a narrow gorge, whose foundations are suitable for the erection of any height of dam required, of any type that may be selected.

Second. A capacious valley above the dam site, with little fall or grade, and affording a reservoir site of capacity commensurate with the size of the stream, with a reasonable height of dam.

Third. An area of arable lands and a resident population requiring water sufficiently extensive to consume all that may be stored in the reservoir, and capable of producing crops of a character and value which will admit of the payment of water rates demanded; these lands being below the elevation of the dam, in its near vicinity, and readily commanded by the stored water through gravity conduits.

Fourth. A watershed above the reservoir of sufficient area to afford adequate run off from the normal rainfall to fill the reservoir periodically with certainty.

Fifth. A fairly reliable average rainfall.

It will be seen at a glance, with a moment's reflection, that the conjunction of all these conditions, each of a favorable nature, must necessarily be rare. The great majority of the mountain gulches, canyons, and torrents, though abounding in dam sites, have no reservoir sites, except perhaps so near the crest of the mountains as to afford but limited water supply to them.

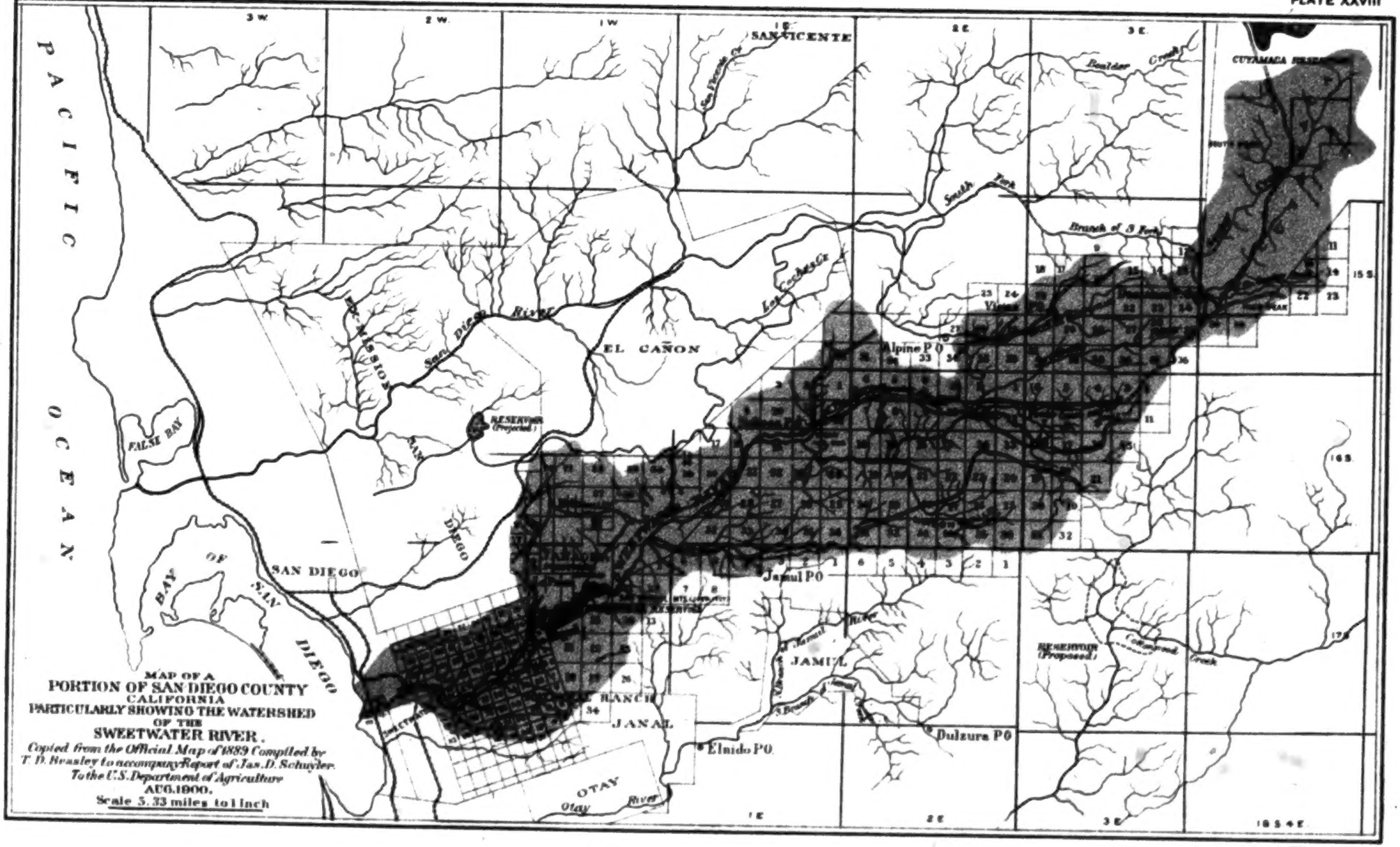
For these reasons it becomes all the more essential that there be no friction between such enterprises as are feasible and the laws of the land which control them.

SWEETWATER RIVER.

PHYSICAL CHARACTERISTICS.

Sweetwater River heads in the Cuyamaca Mountains northeast of San Diego, at an elevation of about 6,000 feet, and empties into the Bay of San Diego but 7 miles north of the Mexican boundary (Pl. XXVIII). Its extreme air-line length is 41 miles, and the total area of its watershed above its mouth is 216 square miles. The watershed is a comparatively narrow trough, 2 to 8 miles wide from crest to crest, and over a portion of its length the stream occupies a rocky gorge that is almost impassable; in fact, there occurs a succession of these gorges from half a mile to 5 miles in length all the way down the stream. The lowest of these is 7 miles above the mouth of the stream, and here is located the Sweetwater Dam, a masonry structure which has become quite universally known (Pl. XXIX). The reservoir above the dam is 3.5 miles in length, and occupies the whole of a valley lying between this lower gorge and the one next above. Both of the lower gorges are cut through the great porphyry dike which traverses the whole of San Diego County parallel with the coast, immediately above which and in contact is granite extending back to the crest of the range and beyond. The site of the dam was extremely favorable for the

PLATE XXVIII


PACIFIC OCEAN
FALSE BAY
BAY OF SAN DIEGO
SAN DIEGO
3 W.
2 W.
1 W.
1 E.
2 E.
3 E.
SAN VICENTE
San Vicente Cr.
Boulder Creek
South Fork
Branch of S. Fork
CUYAMACA RESERVOIR
EX-MISSION
San Diego River
EL CAÑON
Los Coches Cr.
RESERVOIR (Projected)
SAN DIEGO
Alpine P.O.
Viejas
Jamul P.O.
JAMUL
Jamul River
RESERVOIR (Proposed)
Cottonwood Creek
Dulzura P.O.
Elnido P.O.
RANCH
JANAL
OTAY
Otay River
15 S.
16 S.
17 S.
18 S. 4 E.

MAP OF A
PORTION OF SAN DIEGO COUNTY
CALIFORNIA
PARTICULARLY SHOWING THE WATERSHED
OF THE
SWEETWATER RIVER.
Copied from the Official Map of 1889 Compiled by
T. D. Beasley to accompany Report of Jas. D. Schuyler.
To the U.S. Department of Agriculture
AUG. 1900.
Scale 3.33 miles to 1 inch

A. HOEN & CO. BALTIMORE

construction of a safe masonry wall, and its only drawback is its low elevation, the crest of the dam being but 215 feet above sea level, and its lowest outlet 140 feet. The mesa lands along the coast, which are the most desirable for residence and cultivation, on account of their freedom from frost, reach above these elevations, and there has been difficulty in supplying many of those needing water. The watershed area above the dam is 186 square miles. This area has been classified by Mr. J. B. Lippincott, in Bulletin No. 140 of the United States Geological Survey for 1895, as follows:

	Square miles.
Steep and rocky mountains, favorable to large run off	26
Lower rolling mountains, usually covered with brush	99
Rolling hills, covered with soil and disintegrated granite	30
Agricultural lands and river bottom (17 per cent)	31
Total	186

The same authority estimates the mean elevation of the watershed at 2,200 feet, and says, regarding its topography:

> The most noticeable feature of this basin influencing the run off is the abrupt flattening of the slopes at the base of the mountains into agricultural fields. The drainage lines, deeply cut into the steep hillsides, are quickly lost or are poorly defined in crossing the flat alluvial cones or partly filled valleys on the low grounds. In turn, the nearly level fields or parks drain into deep canyons. The occasional flood, caused by a heavy rain rushing down the mountain side, spreads out over the flat lands, much of it disappearing before it can reach the lower canyon. The steady percolation which might be expected at points below is, to a large extent, cut off by the high rate of evaporation, and thus the percentage of run off, taking the basin as a whole, is small.

This watershed area in a region less arid would be considered a sufficient one to afford a reliable supply for a reservoir of even greater capacity than the one now back of the dam. The extreme irregularity of the run off is shown by the following table, made up from measurements taken during the entire period since the completion of the dam:

Run off of the Sweetwater watershed.

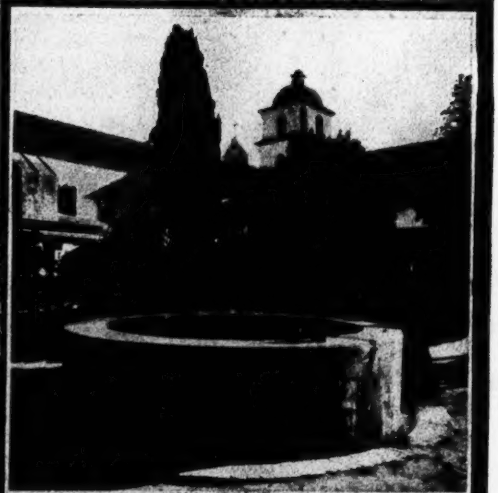
Season.	Rainfall at Sweetwater Dam.	Run off as measured at the dam.	Average yearly run off per square mile.	Total average annual run off.
	Inches.	*Acre-feet.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
1887-88		7,048	0.0524	9.74
1888-89	13.53	25,258	.1875	34.88
1889-90	16.52	20,532	.1525	28.36
1890-91	12.65	21,565.5	.1602	29.79
1891-92	9.88	6,198.3	.0460	8.26
1892-93	11.62	16,260.7	.1210	22.51
1893-94	6.20	1,338.4	.0099	18.45
1894-95	16.19	73,412.1	.5452	101.40
1895-96	7.29	1,320.9	.0098	1.83
1896-97	10.97	6,891.6	.0512	9.52
1897-98	7.05	4.3		
1898-99	5.05	245.5	.0018	.34
1899-1900		0	.0000	
Total		180,070.3		
Mean		13,851.5		20.39

The entire volume of water which has reached the dam in the thirteen years since it was built would cover 180,070 acres 1 foot deep, and if spread over the watershed would cover it a little less than 18 inches deep, or an average of 1.36 inches in depth per annum. During the first eight years of storage the run off was abundant and even excessive, the total volume amounting to 171,608 acre-feet, of which 43.5 per cent was in one year, 1895. The succeeding five years to date have produced but 8,462 acre-feet of run off in all, or only 35 per cent of the capacity of the reservoir. The average of the thirteen years, if it could have been evenly distributed, would have given a yearly volume of 13,851 acre-feet, equivalent to a constant stream of 20.39 cubic feet per second. The water supply being so unevenly divided among the seasons, there has resulted a very great waste, which has amounted to approximately 80,000 acre-feet in all, or 43 per cent of the whole. Of this amount the greater portion was lost during the great flood of January, 1895, when nearly three reservoirfuls of water poured over the dam in a few days. This loss is entirely distinct from the constant unavoidable loss due to evaporation. The waste or loss over the crest of the dam may be classified as avoidable, because it is due solely to the lack of reservoirs of sufficient capacity. Had there been in existence, at the time of the flood of 1895, three additional reservoirs of equal capacity to that back of the Sweetwater Dam not a drop of water need have wasted into the sea during that flood, and the last three years since 1897 would have been years of plenty instead of seasons of drought and shortage. Two, and possibly three, such auxiliary sites exist on the stream and might be made available. One lesson to be drawn, therefore, from the extreme fluctuations of this stream, if it can be regarded as a type for southern California, is that all possible reservoir sites upon it need to be utilized and a great excess of reservoir capacity provided if its waters are all to be utilized and the industries which spring up under established irrigation systems are to be properly safeguarded.

THE DUTY OF THE STREAM.

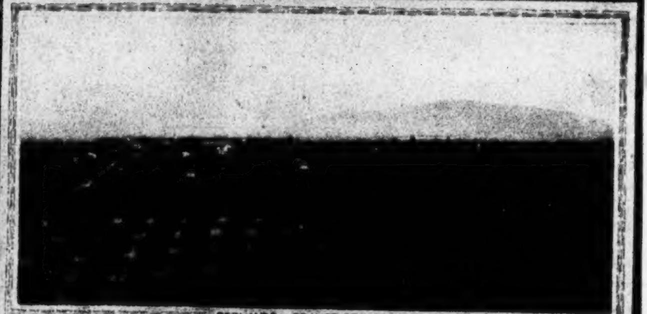
One of the most interesting problems in connection with the utilization of every stream is the determination of the probable maximum duty to be expected from that stream when its waters shall have been conserved to the fullest extent practicable. The solution of this problem should be the work of the United States Government, for it is one of national importance, and too large for any lesser organization to attempt. If it be determined within reasonable limits of accuracy, in advance of the construction of storage works, much ill-advised investment of capital can be saved, and the development of the water supply may be made with a greater certainty as to the results to be achieved. A stream which may have been generally regarded as a reliable supply for irrigating 50,000 acres, for example, might prove, on thorough investigation, to be good for only 10,000 acres. If the discovery of its real duty is made before the distributing system is built over an extravagantly large area, and before water is pledged to more lands than can possibly be supplied, much complication will be avoided and much waste of money prevented. For lack of this sort of information, which it is the function of the Government to gather and tabulate for general use, many ill-advised schemes have been projected throughout the United States, and more are being projected every year, which would be condemned, wholly

TOP OF SWEETWATER DAM



MISSION AT SANTA BARBARA

PALMS AT SAN FERNANDO MISSION



REDLANDS—ORANGE GROVES

LOS ANGELES—ST. JAMES PARK

A SHEEP RANCH

or in part, if their true value were outlined by such preliminary studies. For this reason the experience of the Sweetwater system is of value as a precedent.

The supply of water required in irrigation on the system has been assumed to be about 1 acre-foot per acre per annum, or what is equivalent to 12 inches of rainfall, and this is the volume apportioned by the company as the annual allowance granted in their water-right contracts. The actual use, including the consumption for domestic supply to the inhabitants of National City and Chula Vista, has averaged about 1.5 acre-feet per acre. A rough check on this estimate, which has been arrived at from independent observation and data, is obtained in the following manner: The total run off in thirteen years was 180,070 acre-feet, all of which was used in twelve years; the total amount passing over the top of the dam as waste during this period was approximately 80,070 acre-feet, leaving for utilization and to supply evaporation, 100,000 acre-feet. This 100,000 acre-feet was equivalent to a mean of 8,333 acre-feet per annum over the twelve-year period. Taking this volume as the assumed mean contents of the dam, the mean area of surface exposed to evaporation was 436 acres. As the evaporation loss was measured for several years its mean was ascertained to be about 4.5 feet in depth per annum; and this depth in twelve years would have amounted to 23,544 acre-feet, or 23.5 per cent of the total salvage from the flow of the stream. The remaining 76,454 acre-feet would represent the volume actually consumed in irrigation, after deducting domestic service and leakages.

As a check upon this computation of the total loss by evaporation I have taken the weekly record of gage heights kept without interruption from April 30, 1888, to January 1, 1898, kindly furnished by Mr. Savage; and from the table of areas and contents of the reservoir at different levels I have placed opposite each weekly gage reading the corresponding area of reservoir surface exposed to evaporation. The sum of these areas divided by the number taken each year gives the yearly mean area of surface exposure. From this data I have made the following interesting table:

Reservoir surface exposed to evaporation, 1889–1897.

Year.	Maximum.	Minimum.	Mean.	Remarks.
	Acres.	*Acres.*	*Acres.*	
1889	424	342	372	After April 30.
1889	713	110	500	Emptied by order of court
1890	183	102	140	
1891	642	145	503	
1892	607	446	511	
1893	711	443	583	
1894	549	331	448	
1895	829	333	600	Dam overtopped by flood.
1896	469	224	338	
1897	458	206	316	
Average			431	

This figure of mean surface exposure closely corresponds with that derived by a totally distinct method and affords a gratifying check upon the computation, although a more accurate and more laborious process of reaching the result would be to multiply the measured evaporation each week by the area corresponding and sum up the total instead of taking a mean evaporation loss for a period of years.

Assuming an average consumption of 50 gallons per capita in supplying domestic demand, and estimating the population as 2,500 inhabitants, the volume thus represented would be equivalent to 1,600 acre-feet in twelve years. This quantity being deducted from 76,454, and the remainder divided by 12, the quotient is 6,230 acre-feet as the average volume of water applied to the lands annually during the twelve years. The area irrigated in 1896 reached a maximum of 4,580 acres. If a mean area of 4,000 acres be assumed as having been irrigated, the mean depth of water applied, by the above computation, would be 1.56 feet. This is, of course, a very rough approximation of the probable consumption during the period in question. It is closely corroborated by numerous meter measurements of the volume applied to certain known areas, so that the actual use may be fairly closely stated to have been 1.5 feet in depth per annum.

There has been a growing conviction, however, that the orchards would have thrived equally well, and perhaps better, with a more moderate application of water. The experience gained in the care of bearing orchards since the great drought compelled the company to seek and develop an independent source of supply have shown that the trees will live and bear with an extremely small allowance of water. The history of the use of water in 1899 is extremely interesting. At the beginning of the irrigation season the reservoir contained barely 40,000,000 gallons of water. By the sinking of numerous wells in the upper part of the reservoir valley and in the valley below the dam, and by the establishment of elaborate pumping plants, the company developed and pumped 457,000,000 gallons, of which they estimated 140,000,000 gallons were used in supplying domestic service and for mechanical purposes, leaving 317,000,000 gallons as the amount of pumped water used in irrigating 3,800 acres of orchard, chiefly citrus fruits. This, added to the 40,000,000 gallons in the reservoir, gave a total volume of supply of 1,096 acre-feet. Thus the average depth of water applied was but 0.288 feet, or 3.375 inches. The irrigation was supplemented by thorough cultivation, and the orchards, when thus cared for, were quite thrifty and bore heavily. In fact, the lemon crop was never so heavy as the one following the drought of 1899. The water used was but 18.5 per cent of the average amount previously applied. Still it can not be argued from this experience that such extreme economy could be practiced as a regular thing. It appears to be the general opinion now among the irrigators that they have heretofore used more water than necessary, and that the allotment of 1 acre-foot per annum (326,000 gallons per acre, or 12 inches in depth) is ample for their orchards and all other crops, except alfalfa, which requires rather more. This being accepted as a reasonable allowance, the maximum possible duty of Sweetwater River in irrigation, based on the measured run off of thirteen years, may be deduced as follows, assuming that ample storage capacity be provided: The average annual run off is 13,492 acre-feet, of which the loss by evaporation from the surface of reservoirs may be 25 per cent. This would leave 10,119 acre-feet as the average volume available for actual irrigation, which would irrigate 10,119 acres.

In short had there been more reservoirs on the Sweetwater, having a combined storage capacity of 75,000 acre-feet (instead of 18,000 before the flow of 1895 and 22,500 since the following year), the stream flow since 1887 would have amply irrigated about 10,000 acres of land chiefly in orchard without the panicky conditions resulting from successive droughts. But with conditions as existing to-day, having a reservoir of but 22,500 acre-feet capacity, the safe duty of the stream is probably less than 3,000 acres, without having to resort to pumping an auxiliary supply during dry seasons.

To provide for the contingencies of drought and losses by evaporation in streams of this class, judging solely from the record of thirteen years, it would appear to be essential to provide 7.5 acre-feet of storage capacity for each acre desired to be irrigated. Having such storage provided, the area which may be irrigated from the catchment of a given watershed is approximately one-twelfth of the area of the watershed. These deductions may be modified with further experience, and would only apply to similar conditions of soil, climate, and character of run off.

Sweetwater River is essentially a stream for storage utilization only. It has practically no living water, except at its extreme sources and for 10 or 20 miles down from the summit of the range. From June to the following November or December there is rarely any flow into the Sweetwater Reservoir. For this reason there have been practically no attempts to utilize the normal summer flow for irrigation, except in a very small way.

CLAIMS TO THE WATER OF SWEETWATER RIVER.

The uncertain character of the stream can very well be judged by an inspection of the records of water claims filed in the county recorder's office at San Diego. The following table gives an abstract of all the claims of record on the stream, giving the essential points of each claim:

Filings on water of Sweetwater River in the county recorder's office, San Diego, Cal.

No.	Date.	Name of claimants.	Amount claimed.	Point of diversion.	Purposes.	Means of diversion.
1	June 15, 1885	W. J. Lyons and T. H. King.	4,000 inches, measured under a 4-inch pressure.	SE. ¼ of sec. 33, T. 15 S., R. 3 E.	Manufacturing, agricultural, domestic.	Flume, ditch, or pipes not less than 15 or 20 inches in diameter.
2	Aug. 17, 1885	Milton Santee	5,000 inches, measured under a 4-inch pressure.	W. ½ of sec. 23, T. 15, R. 3 E.	Irrigating, domestic	12-inch pipe, flume, and ditch.
3	....do	Chas. A. Dexter	4,000 inches, measured under a 4-inch pressure.	S. ½ of sec. 27, T. 15 S., R. 3 E.	Manufacturing, irrigation, agricultural, domestic.	Flume, ditch, or pipe not less than 15 inches in diameter.
4	....do	....do	....do	S. ½ of sec. 28, T. 15 S., R. 3 E.	....do	Do.
5	....do	....do	....do	S. ½ of sec. 33, T. 15 S., R. 3 E.	....do	Do.
6	Apr. 12, 1885	W. G. Rifenberg, for Alpine Water Co.	....do	SE. ¼ of sec. 33, T. 15 S., R. 3 E.	Manufacturing, agricultural, and domestic.	Flume, ditch, or pipe not less than 10 inches in diameter.
7	Oct. 14, 1885	Mrs. Chas. A. Dexter	8,000 inches, measured under a 4-inch pressure.	S. ½ of sec. 28 and NW. ¼ of sec. 23, T. 15 S., R. 3 E.	....do	Flume, ditch, or pipe not less than 15 inches in diameter.
8	Dec. 11, 1885	J. K. Mulkey	4,000 inches, measured under a 4-inch pressure.	NW. ¼ of sec. 11, T. 17 S., R. 1 W. (This is at head of present Sweetwater Reservoir.)	....do	Flume, ditch, or pipes not less than 10 inches in diameter.
9	Dec. 3, 1885	W. E. Robinson and T. S. Van Dyke, for San Diego Flume Co.	....do	Description locates near Dehesa.	Domestic, irrigation, and mechanical.	Dam, flume 4 feet wide, 4 feet deep; iron pipes 20 inches diameter.
10	Mar. 19, 1886	James B. Dunkerley	20,000 inches, measured under a 4-inch pressure.	S. ½ of secs. 27 and 28, and NW. ¼ of sec. 33, T. 15 S., R. 3 E.	Manufacturing, irrigation, domestic, agricultural.	Flume, ditch, or pipe not less than 15 inches in diameter.
11	June 23, 1886	San Diego Flume Co	2,000 miner's inches, measured under a 4-inch pressure, "whether above or below ground."	1½ or 2 miles above Descanso, in Guatay Valley.	Not given	Flume, ditch, tunnel, or other aqueduct 4 feet wide and 4 feet deep.
12	July 22, 1886	J. S. Taylor	All flowing above or below ground to bed rock, to the amount of 10,000 inches, measured under a 4-inch pressure.	The falls on the Cuyamaca road.	Irrigation and domestic	Dam over 50 feet high, one or more reservoirs above open ditches, flumes, tunnels, and pipes.
13	Aug. 7, 1886	T. F. Miller	5,000 inches, etc	In or about T. 16 S., R. 1 E.	Not given	A flume, ditch, or pipe not less than 15 inches in diameter.
14	Sept. 25, 1886	Fred Copeland	5,000 inches, measured under a 4-inch pressure.	NE. ¼ of sec. 24, T. 16 S., R. 1 E. (above Dehesa).	Irrigation	Dam, pipe 24 inches in diameter, and a flume 4 by 6 feet.

15	Sept. 24, 1886	Wm. G. Dickinson	5,000 inches, measured under a 4-inch pressure, the water flowing and which shall hereafter flow.	Present site of Sweetwater Dam.	do	Dam, iron pipe 24 inches diameter, and flume 4 by 6 feet.
16	Aug. 10, 1886	J. R. McFarlan	Claims all reservoir sites on the Sweetwater, commencing 1 mile above Jas. Yates's place in T. 16 S., R. 1 E.	About 100 feet higher than the head of the flume, ditch or pipe of T. F. Miller.	Not given	Flume, ditch, or pipe to carry 4,000 inches, more or less.
17	Mar. 26, 1887	Charles Ellis	All the water	NE. ¼ of sec. 25, T. 15 S., R. 3 E., about 1 mile below Descanso.	Irrigation	Not stated.
18	Apr. 1, 1887	Wm. G. Dickinson	5,000 inches	Center of stone dam now being built by the San Diego Land and Town Co.	Culinary, household, irrigation, and other.	Stone dam, iron pipe, and a flume 4 by 6 feet.
19	June 27, 1887	Geo. D. Copeland, for San Diego Flume Co.	All the waters to the extent of 500 inches, meas- under a 4-inch pressure.	At first rocky gorge at the outlet of Japatul Valley.	Not given	Flume, ditch, tunnel or other aqueduct 2 feet wide, 2 feet deep, iron pipe 12 inches in diameter.
20	Aug. 24, 1888	San Diego Land and Town Co., by Wm. G. Dickinson.	75,000 inches of continuous flow, measured under a 4-inch pressure.	The Sweetwater Dam	do	26-inch pipe.
21	Not given	Frank A. Knox	2,000,000 inches per second, measured under a 4-inch pressure.	In T. 16 S., R. 1 E., S. B. M	Domestic, mechanical, agricultural, horticultural, and irrigation.	Dam and 2 closed conduits of sufficient size and capacity.
22	do	do	do	SE. ¼ of NE. ¼ of sec. 17, T. 16 S., R. 2 E.	do	Do.
23	July 27, 1891	Sylvester Murphy	500 inches from Lawson Valley Creek, a tributary of the Sweetwater.	W. ½ of NW. ¼ of sec. 28, T. 16 S., R. 2 E.	Irrigation	Not given.
24	Nov. 15, 1892	F. D. C. Meyers	5,000 inches, measured under a 4-inch pressure, from Gantay Creek.	Lot 4, sec. 7, T. 15 S	Irrigation, etc	Ditch, flume, or pipes.
25	Jan. 31, 1896	San Diego Land and Town Co.	15,000 cubic feet per second, whether above or below ground.	NE. ¼ of sec. 17, T. 16 S., R. 2 E.	Irrigation, domestic, mechanical, manufacturing, and power.	Dams, pipes, flumes, ditches, and other conduits, the pipes to be 4 inches diameter.
26	Jan. 11, 1897	P. W. Beck and W. J. Bower.	35 miner's inches	100 feet west of east line of quarter section 111, National Ranch, north side of river.	Irrigation	Ditch or flume.
27	Feb. 26, 1898	San Diego Land and Town Co.	500 miner's inches, measured under a 4-inch pressure, whether above or below ground.	West line of quarter section 72, National Ranch (Linwood).	Domestic, irrigation, mechanical, and manufacturing.	Pumps and pipes 18 inches in diameter.

Filings on water of Sweetwater River in the county recorder's office, San Diego, Cal.—Continued.

No.	Date.	Name of claimants.	Amount claimed.	Point of diversion.	Purposes.	Means of diversion.
28	Mar. 1, 1899	San Diego Land and Town Co.	1,000 miner's inches, measured under a 4-inch pressure.	NW. cor. sec. 31, National Ranch (Sunnyside plant).	Not given	Wells, pumps, flumes, and 24-inch main pipes.
29	do	do	1,000 miner's inches	W. ½ of sec. 73, National Ranch (Bonita).	do	30-inch main, and wells, pumps, and flumes.
30	do	do	do	W. ½ of sec. 58 (Bonnie Brae).	do	Do.
31	do	do	do	N. ½ of sec. 98 (Linwood, upper).	do	Do.

Reviewing this tabulation of recorded claims, the following comments and notes as to the purpose and status of the claims, so far as known, will be pertinent: The first seven filings in the table, made between June and October, 1885, were all posted at practically the same place, some 6 miles east of Alpine and 4 to 5 miles southwest of Descanso, in the rocky gorge of Sweetwater River, at an elevation of about 3,000 feet above sea level, and were evidently made in the interest of a project for supplying the city of San Diego with water. This project never passed the promoter stage and the claims are manifestly invalid.

Claim No. 8, for 4,000 inches, purported to be for a similar project, diverting water from the stream at the gorge immediately above the upper end of the reservoir subsequently formed by the Sweetwater Dam. No work was done to make the claim valid.

Claim No. 9, for 4,000 inches, was located as a part of the system of the San Diego Flume Company, and although no work has ever been done upon the stream to effect the actual appropriation of the water it has been alleged that the claim was made valid by the construction of the main flume from the adjoining stream. This illustrates one of the unfortunate features of the statute of California providing for the appropriation of water, wherein there is a great uncertainty as to the length of time a filing of this character might take precedence over a bona fide filing accompanied by diligent prosecution of work and actual appropriation. There appears to be no question, however, that the lapse of years, without any work whatever, would invalidate any claim.

Claim No. 10 is of the same character as claims Nos. 1 to 7, and is located at the same point on the stream. It was also to serve a project for supplying San Diego, and claimed the modest amount of 20,000 inches.

Claim No. 11 is in the same category as No. 9, and was filed by the San Diego Flume Company as an auxiliary to the general system. The point of diversion in this claim is in Guatay Valley, over 3,500 feet in elevation, and near the headwaters of the river. A flume and ditch were projected to divert this water across the divide, whence it would flow to the flume by way of the South Fork of San Diego River. Claim No. 9, on the other hand, was located at the lowest point on the river, from which water could be diverted into the company's flume.

Claim No. 12, for 10,000 inches, was presumably filed to hold a sufficient water supply to irrigate meadow lands in the high mountain valleys of the Cuyamaca Ranch. It is absurdly large, as the stream has probably never carried 10 per cent of this volume at the point where the appropriation was to have been made. There was never any work done to perfect the claim or make the appropriation a bona fide one.

Claim No. 13, for 5,000 inches, was located at the gorge between the mouth of Lawson Creek and Dehesa, where an elevation of 800 to 1,000 feet is obtainable for a diverting dam. Claims Nos. 9, 13, 14, 16, 21, 22, and 25 in the above table are all located in practically the same place on the stream, at a commanding elevation, from which water may be taken under pressure to all of the mesas and valleys of the western portion of San Diego County. None of these claims, however, have been succeeded by actual appropriation and use of the water.

Claim No. 15, for 5,000 inches, made by William G. Dickinson, September 24, 1886, was the first filing on the site of the present Sweetwater Dam, a few days before the beginning of construction on the dam and distribution system. Work was continuously prosecuted until the completion of the system in April, 1888. This filing was made, manifestly, in the interest of the San Diego Land and Town Company, by its then general manager, William G. Dickinson, although in his individual name. It has undoubtedly become a valid claim upon the water, and has priority over all others. There is nothing in the water-right records to indicate whether or not this claim has ever been transferred to the San Diego Land and Town Company by Mr. Dickinson or his heirs, and a search of the records in other books than those of water claims would be necessary to determine this point.

Claim No. 17. On the 1st day of April, 1887, William G. Dickinson filed another claim, in his individual name, to 5,000 inches, which was posted at the same point as claim No. 15, viz, the Sweetwater Dam, and designating as the point of diversion "the center of the stone dam now being built by the San Diego Land and Town Company." Whether this claim should be regarded as supplemental to claim No. 15, or as amendatory thereto, or a substitute therefor, is quite indeterminate. Both claims are in every respect alike, and as there had been no cessation of work between the respective dates of their filing there could have been no forfeiture of the first claim which necessitated a renewal of the recorded notice to the world. If the claim be considered as supplemental to claim No. 15, making a combined claim of 10,000 inches instead of 5,000, the question arises as to why this was necessary to protect the rights of the appropriator, and what should be the interpretation of any claim to water for a reservoir as these claims are ordinarily expressed. If an individual or corporation builds a reservoir and files a claim to, say, 5,000 inches, and the flow of the stream in freshet sometimes exceeds the 5,000 inches by fifty or one hundred times, should they be limited to the 5,000 inches while it was flowing, and be required to allow the surplus over and above 5,000 inches to pass by them to subsequent appropriators, if there were such, or should the amount of the filing be considered as an average volume of 5,000 inches for the year, or the irrigation season, or the rainy season? Again, if the reservoir could be filled by the average flow of 5,000 inches for a shorter period than the irrigation season, the definition of the rights under the appropriation of 5,000 inches would still be very obscure and susceptible of serious conflict if there were contending claims to the stream.

Claim No. 20, for 75,000 inches, filed by the San Diego Land and Town Company, through William G. Dickinson, general manager, August 24, 1888, was evidently the outcome of a discussion of these questions, and in order to make the appropriation cover all the flow of the stream up to what was supposed to be the extreme limit the amount was placed at 75,000 inches (1,500 cubic feet per second), which was the estimated maximum discharge, judging by high-water marks remaining in the canyon at the time the dam was built. This discharge was greatly exceeded during the freshet of 1895, when the average flow for one hour was 18,150 cubic feet per second, or 907,500 miner's inches under a 4-inch pressure. The company did not need so much water, and would have been well satisfied to have had some other appropriator take all the surplus over and above the amounts named in the several filings before it reached their reservoir. However, they have made good their combined appropriations of 85,000 inches, whenever such an amount of water was flowing in the stream, and these claims are the only valid ones of any moment on the river.

Claim No. 16 is not a filing for any specified volume of water, but claims "all reservoir sites on the Sweetwater, commencing 1 mile above James Yates's place in township 16 S., R. 1 E.," which is in the general locality where claims Nos. 9, 13, 14, 16, 21, 22, and 25 were posted.

Claim No. 17 is a filing by a ranch owner living on the stream high up in the mountains, some 4 miles below Descanso, and claims "all the running water of the Sweetwater Creek, for irrigating purposes." The filing does not state where the water is intended to be used, but presumably on the lands riparian to the stream, immediately below the point of diversion. A small appropriation has been made under this filing, the volume of which is too insignificant to have any appreciable effect on the reservoir appropriations made below, or any that may in future be made.

Claim No. 19, to 500 inches from Japatul Valley, a tributary of Sweetwater River, was made by the San Diego Flume Company as a part of its general system, and is in the same condition as all the filings made by this company on adjacent watersheds, where no actual work of appropriation has been performed. The claim is doubtless invalid.

Claims Nos. 21 and 22, for "2,000,000 inches," may be classified among the boom absurdities which came to naught.

Claim No. 23 is for "500 inches of water" from Lawson Valley Creek, a small tributary of Sweetwater River. The object of the filing was evidently for local farming appropriation. The stream is normally of very slender volume and the only actual use made of it in irrigation is by a farmer residing on a small tract at its mouth, and gathering about 30 miner's inches into a small flume.

Claim No. 24 is for 5,000 inches, and is located so near the head of the stream as to be insignificant in actual realization. It was intended for local use, and a ditch has been built to divert the water of Guatay Valley upon the adjacent meadows and fields of alfalfa, but the actual appropriation is small and is practically negligible in its effect upon reservoirs located down the stream.

Claim No. 25, for "15,000 cubic feet per second," was made by the San Diego Land and Town Company at a time when they seriously contemplated the construction of a second reservoir on the stream at a point above and near the mouth of Lawson Creek, about one year subsequent to the great flood. The purpose held in view in constructing this secondary dam and reservoir was to conserve more water, and at the same time command higher lands belonging to the company, which needed a water supply. The large volume of water brought down by the stream during the freshet brought with it a regret that there was not more storage capacity to impound it. The company made surveys of the dam site and reservoir basin, and found a satisfactory dam site where the width of the gorge is but 50 feet at bottom, and 320 feet wide at a height of 70 feet. The walls are of hard granite, of excellent quality for building purposes. The reservoir will cover an area of 147 acres at the 70-foot contour, and impound 3,470 acre-feet. A dam at least 150 feet high will probably be required to form a reservoir of equal capacity to the one already built. The new dam site would have an elevation of 1,230 feet at the base. The company did no work to perfect its title to the water, and the claim is invalid. The size of the claim, "15,000 cubic feet per second," is an indication of the opinion of the engineer that this amount would cover the entire stream flow of maximum floods, even in a freshet like that of 1895, the previous year.

Claim No. 26, for 35 inches, represents a temporary appropriation made of the stream some 4 miles below the dam. The flow at this point is intermittent at best, but since the building of the dam is only apparent after the reservoir is filled.

Claims No. 27, 28, 29, 30, and 31, by the San Diego Land and Town Company at different points in the Sweetwater Valley below the dam, are for the protection of the well developments supplying the various pumping plants erected in the past two years for obtaining an auxiliary supply to the system, rendered necessary by drought. Claim No. 27 is for 500 inches and the others are for 1,000 inches each, or 4,500 inches in all. They are all claims upon the underflow, and, although they are each of larger volume than the total amount which has been developed, they have all been made valid to a greater or less extent by the construction of plants with which to collect and draw the water to the surface, and make good the appropriation to the utmost possible extent.

The appropriation of subterranean water is legal according to a recent decision of the California supreme court in the case of the Vineland Irrigation District *v.* The Azusa Irrigating Company et al.

The following extract from the syllabus of the case (126 Cal., 486) gives the general tenor of the decision on this important point, which had never previously been clearly decided:

> (1) The subsurface flow of streams in this State may be appropriated for useful purposes by proper means for the development and use thereof, with due regard to the prior rights of others in the stream. Such appropriation is legal only in so far as it does not imperil or impair the superior rights of others in the surface flow of the stream.

Reviewing the recorded claims to water from the Sweetwater River, as they appear on the records, it is impossible for any person unfamiliar with the stream or the country and its inhabitants to be able to judge which of the claims are valid and which are not, which are repetitions and refilings, and which of any two or more filings by the same parties are merely amendatory of previous filings or additions to prior claims. There are 31 claims in all, aggregating 4,923,535 miner's inches under a 4-inch pressure, while the average flow for thirteen years has been but 1,000 inches. The claims are, therefore, for about 5,000 times the existing supply.

As far as the writer is able to judge but ten of these recorded claims, one of which ten is quite indefinite as to amount, have been made good by actual appropriation, viz, claims No. 15, 18, and 20, for 85,000 inches in the aggregate, for the supply of the Sweetwater Dam, and owned by the San Diego Land and Town Company; claims No. 27, 28, 29, 30, and 31, by the same company, covering an aggregate of 4,500 inches of the underflow of the stream below the dam; claim No. 17, by Charles Ellis, on the Upper Sweetwater, of "all the running water," and claim No. 24, by Frederick D. C. Meyers, for 5,000 inches. The aggregate of the nine claims which state definitely the volume claimed is 94,500 inches measured under a 4-inch pressure, which is equivalent to 1,890 cubic feet per second. This great aggregate seems quite moderate when compared with the extreme flood volume of the river, as the greatest recorded flood—that of 1895—was nearly ten times this quantity at the period of the maximum flow.

DIFFICULTY OF FINDING CLAIMS TO WATER IN RECORDS.

The claims to water which were filed in San Diego County prior to 1893 were recorded in the miscellaneous records and scattered through six volumes, with no clue to their whereabouts, except the note of "water notice" in the index. To find any claim posted prior to 1893, therefore, it is necessary to look at every one in the index which is marked "water notice," a task which is laborious, to say the least. In the first two volumes of the water-claim records there is no index to the streams, and to find the claims filed upon any stream it is necessary to examine every claim recorded in the first two volumes of water claims, as well as those in the six volumes of miscellaneous records. The third volume is so indexed that any claim upon any stream can be quickly found, and the records are conveniently arranged for reference, as they should be. In cases of county division the claims to water on certain streams must be looked for in the records of both counties at their respective county seats. An example of this sort occurs in the division of San Diego County to form Riverside County. San Jacinto River is not wholly within the boundaries of Riverside County, and one who is in quest of information as to the claims of water on that stream must visit the county seats of both counties, 130 miles apart, and search through the records of each. In Riverside County the water records were begun June 9, 1893, and from that time to May 15, 1900, something over 300 claims had been filed. They are all recorded in one book devoted to water claims, with an index which shows, in separate columns, the month, day, and year of the posting of the notice; the month, day, and year of the recording of the claim, the name of the claimant, the stream upon which the claim is made, and the book and page of the record. This is a very satisfactory index, and one can find all claims to any particular stream by simply going through all of the index. The methods and records of the newer county in this respect are, therefore, much in advance of those of the older one.

In neither of them, however, is there any way of determining the validity of the claim from any existing record. There is an entire absence of anything like an adjudication of water rights, or any sort of proof of the validity or invalidity of the great mass of recorded filings. The law does not require any such proof to be made, and therefore none is made and the records are barren of all evidence as to whom the water really belongs. No doubt there are valuable rights that have been acquired on the stream, but no one knows definitely their extent or volume, and such information can be acquired only by a formal judicial inquiry and a determination made by court decree.

UNRECORDED WATER RIGHTS.

There are water rights existing in the stream which depend for their validity upon actual appropriation and prescriptive use, and not upon a recorded claim. The first of these above the Sweetwater Reservoir was a ditch appropriation made by David Little, on lands at the head of the reservoir. A small ditch was taken out in the rocky gorge above the reservoir and used to irrigate a few acres, but it was abandoned in 1887. The land from above the point of diversion to and including the original tract irrigated was purchased by the San Diego Land and Town Company in 1895, after the dam and reservoir were enlarged.

Some 4 or 5 miles higher up the stream, in the Jamacha Valley, a development and diversion of underground waters was made and installed about 1896 by George L. Davis. The development was made by means of an inverted flume placed about 10 feet under the surface. About 40 miner's inches of water is said to be available by this development in the dry season of the current year, 1900. The water is raised to the surface and delivered to a reservoir with some 350 feet lift by the use of a 25-horsepower gasoline engine.

Some 4 miles higher up the stream on sec. 16, T. 16 S., R. 1 E., Mr. R. C. Allen has a well, dug in 1893, 10 feet in diameter, 25 feet deep, and 1,000 feet from the bank of the stream channel, from which he pumps water to irrigate his vineyard and olive orchard, using a Webber high-lift centrifugal pump and an 8-horsepower gasoline engine. The maximum lift is about 70 feet, but much of the water is lifted but 10 to 15 feet. In ordinary seasons he can pump 35 to 40 miner's inches, but in 1899 and 1900 he was able to draw only 25 inches from the well. The well was rather unsatisfactory prior to the freshet of 1895, and gave a meager supply of water, but the flood waters of that freshet filled the river bed with sand and raised the plane of saturation throughout the valley to such an extent that the well has since been inexhaustible with the plant installed. Where the water level was formerly 14 feet below the surface in the well, it now stands at 7 feet.

The well was sunk by means of a casing or shoe of galvanized iron, so perforated as to permit water to enter, but to keep out quicksand. This shoe is 5 feet in height, and heavily braced with angle irons inside. Above this shoe the lining of the well was continued with a circular brick wall of the same diameter, reaching to the surface. It was hoped to be able to pass through the quicksand by this device, but they had to stop in the quicksand at a depth of 25 feet.

At the mouth of Lawson Creek, Judge W. A. Sloane has a ranch irrigated with water taken from Lawson Creek. The ditch has a capacity of 10 to 15 miner's inches, and the area irrigated is 30 to 40 acres.

There are also several small irrigation plants in Green Valley, Japatul Valley, and Viejas Valley, with water from the living streams, and in the main valleys of the stream below are numerous wells from which water is pumped for irrigation and domestic use on a small scale, none of which have corresponding claims to water on file in the county records. The aggregate of these is small and unimportant.

Below the dam a development and appropriation of underground water was made in 1898 without filing a claim to it in the county recorder's office, by Mr. C. A. Hardy, at the Bonnie Brae Alfalfa Ranch. A sump was excavated by scrapers and teams, and water percolated into it from the sides through the sand. A 4-inch centrifugal pump, actuated by a 4-horsepower gasoline engine, was installed and pumped about 25 miner's inches of water to supplement the inadequate supply of the Sweetwater system. A fine growth of alfalfa was maintained by this means, but the constant scraping with teams required to keep up the supply in the sump pit, and the cost of pumping, rendered the scheme unprofitable, and it was abandoned in August, 1898, the land reverting to the San Diego Land and Town Company, from whom it had been purchased on a partial payment basis.

THE DUPLICATION OF THE SWEETWATER DAM WATER SUPPLY SYSTEM BY SUBTERRANEAN WATER DEVELOPMENTS.

The succession of droughts, or years of rainfall below the normal, beginning after the wet season of 1894–95, and continuing to the present time, have compelled the San Diego Land and Town Company to resort to extraordinary measures to provide a sufficient supply for domestic consumption, and to keep alive the orchards depending upon the system for their sole means of sustenance. It is certainly unusual, if not actually unprecedented, for a water company, depending upon a stream run off and catchment for its supply, to be compelled to dig wells, establish pumping plants, and develop an entirely new and independent source to tide over the emergency of drought. An account of the struggle of the company for water with which to substitute the great lake that normally exists behind the dam, but is now dry, can not fail to be interesting.

The season of 1895–96 gave a run off of but 1,320 acre-feet, one fifty-fifth of that of the preceding year; but as 1895 had started with a full reservoir, the supply for 1896 was ample. The run off for 1896–97 was again short, amounting to but 6,892 acre-feet, and it was only with careful economy that the season of 1897 was passed over. The following rainy season was still worse in yield, as it gave practically nothing to the depleted reservoir, and at the beginning of 1898 the supply left in the reservoir was very small indeed, and the season was passed only by the exercise of the most rigid economy, by the apportionment of the water in extremely small quantities, and by the general use of meters on the system. In September of that year the San Diego Land and Town Company installed a small pumping plant on quarter-section 111 of the Rancho de la Nacion, near Chula Vista, drawing water from seven 2-inch drive-point wells, placed 30 feet apart on a suction pipe, to which was attached a 2.5-inch Lawrence centrifugal pump, driven by a 5-horsepower gasoline engine. This produced about 7 miner's inches, which was delivered to an adjacent orange orchard belonging to the company. The cost was excessive, and the plant was removed after sixty days' operation.

In October, 1898, the company made a second attempt to develop water on quarter-section 85 of the Rancho de la Nacion, about 1 mile above the plant just described. They put down eight 2-inch drive-point wells, about 12 feet deep, 30 feet apart, connecting them by a 4-inch suction pipe, and pumping water to other orchards belonging to the company. The water thus developed amounted to about 10 miner's inches, and was used only on the orchards belonging to the company. The plant was operated for forty-five days, when it was dismantled. It consisted of one double-cylinder well pump, with cylinders 6 inches in diameter, actuated by a 4-horsepower gasoline engine.

In December, 1898, as the reservoir had failed to fill and the little water left was unfit for domestic use, the company was obliged to seek for a domestic supply for the general public depending upon its system. Fourteen 2-inch drive-point wells were put down in the space of an acre or two of ground in the valley near Sunnyside, on quarter section 31. These were driven to a depth of 16 feet, and were spaced 30 feet apart. The pumping plant consisted of a triplex-acting pump, with plungers 5½ by 8 inches, actuated by a 5-horsepower gasoline engine. About 15 miner's inches of water was thus obtained, which was delivered into the mains and was the main domestic supply until July, 1899. The plant was known as "the domestic pump," and supplied domestic water from the day of its installation, December 10, 1898, until the following July, when it was substituted by a larger plant, now called "pumping plant No. 2," which is the fourth plant installed by the company, and was put into use May 24, 1899, a short distance above the domestic pump, on the same quarter section.

The continuation of the drought had by this time made it manifest to the company that it was necessary for them not only to continue pumping for domestic supply to all their customers, but to develop sufficient water to irrigate the 4,000 acres previously irrigated from the reservoir and dependent upon the system for its existence. The first plant put in for this purpose consisted of 32 3-inch hydraulic wells, placed in line across the valley to a uniform depth of 35 feet, and spaced evenly 30 feet apart along the suction pipe. This pipe was 10 inches in diameter from the pump for 300 feet, followed by 300 feet of 8-inch, and that in turn by 300 feet of 6-inch screw casing pipe, 900 feet in all. The pumping plant consisted of a compound duplex steam pumping engine, with a capacity for pumping 1,750,000 gallons in twenty-four hours. An 80-horsepower horizontal tubular boiler furnished steam for the pump, which delivers water directly into the Sweetwater pipe system. The water thus developed amounted to about 100 miner's inches.

While this plant was in progress of installation work was being actively pushed on a similar plant of large scale for development of additional irrigation water. This was located several miles down the valley at Linwood Grove, on quarter section 98, Rancho de la Nacion. Seventy-five 3-inch hydraulic wells were put down to a uniform depth of 50 feet, spaced 30 feet apart, in 2 rows along either side of suction mains which radiated from the central pumping station with the cardinal points of the compass. The longest of these suction mains was over one-fourth mile. One well, No. 76, was bored to a depth of 270 feet. The total test yield of all the 76 wells was about 400 miner's inches. The plant for pumping consisted of two 80-horsepower horizontal tubular boilers, and two Worthington compound duplex steam pumping engines, one of which has a capacity of 2,250,000 gallons daily, and the other 1,250,000 gallons per twenty-four hours. The works were installed June 9, 1899. They deliver water directly into the mains of the company.

Continuing the search for water the company next installed a sixth plant, which was a restoration of the development of C. A. Hardy, on quarter section 47, above described, which had been abandoned the previous August. Here, instead of the open sump, the company put down fourteen 2-inch drive-point wells, 10 feet deep, and five 3-inch hydraulic wells, 50 feet deep, to all of which was attached a 5-inch Krogh centrifugal pump, by suitable suction pipe, driven by a 12-horsepower Fairbanks & Morse gasoline engine. This plant developed 33 miner's inches, which was used on the 40-acre alfalfa field.

At the same time that the last three plants were being installed work was progressing on two auxiliary pumping plants located in the bed of the reservoir itself. The first of these, designated by the company as Plant A, is located at a point about 1 mile above the dam, where the sandy bottom lands are about 600 feet wide between the low mesas of heavy soil on either side. Ten wells, or shafts, 6 by 6 feet, 15 feet deep, were sunk in a straight line, 60 feet apart, and curbed with wood. A 6-inch suction pipe was laid in a trench by the side of the wells, some 6 feet deep, with 2-inch branches extending to and into each well. The pump used was a 5-inch Krogh centrifugal, actuated by a 12-horsepower Fairbanks & Morse gasoline engine. The water was lifted a total height of 30 feet to a flume, whence it flowed by gravity down the reservoir to the outlet tower, where the water was emptied into the tower, and so reached the system in the ordinary way under a head of about 20 feet at the dam. This elevation above the bottom left an opportunity to collect a pond of small size below that level, in the lower part of the reservoir next to the dam, the surface level of which was lower than the surface of water in the wells above. The volume of water developed by this plant was about 25 miner's inches.

The second plant in the reservoir bed was placed about two-thirds of a mile above Plant A, and is called Plant B. It was a duplicate of Plant A in every respect, and yielded the same quantity of water. A flume reached down from B to A and the water thus pumped was delivered with that obtained from Plant A. Both A and B were discontinued and removed November 1, 1899, after having operated continuously for six months, at the average yield of 50 inches for the two. It was anticipated the stream would surely yield a large run off during the season of 1899–1900, and that there would be no further need of pumps to maintain the supply. They were replaced, however, in the latter part of May, 1900, and resumed pumping about June 1. The total yield of water derived from the bed of the reservoir last year was about 360 acre-feet.

Next in order of development are the two plants installed by the Sweetwater Fruit Company at Bonita, in Sweetwater Valley. This company has lands riparian to the stream bed, and on March 16, 1899, installed Plant B at a point opposite the Bonita schoolhouse. This plant consists of a 5½ by 8 inch triplex-acting pump, actuated by a 12-horsepower gasoline engine, delivering water with a maximum lift of nearly 125 feet through a 4-inch casing pipe. The volume obtained at this point is about 15 miner's inches, which is developed by means of an open trench, excavated in the immediate river channel. Theoretically the pump at 60 revolutions should deliver 16⅔ miner's inches, and it was usually run at 70 revolutions per minute. With the allowance for slip, the delivery was estimated at 15 inches. An auxiliary to the plant is a 6-inch centrifugal pump for dredging the sump and pumping water to an alfalfa field and walnut orchard on the adjacent low bottoms. Plant A is located at the Bonita store one-half mile below Plant B; was completed in April, 1899, and has developed about the same quantity of water, 15 miner's inches, from a similar open trench in the river channel. This is forced to the distributing system of the ranch with a lift of 60 feet, by means of a 5½ by 8 inch triplex-acting Smith-Vaile pump, actuated by a 15-horsepower Otto gasoline engine. A 3-inch centrifugal pump is attached for dredging the sump at the pump, and for low lift to supply irrigation to adjacent bottom lands. The total pumping operations of the Sweetwater company for 1899 resulted in a combined discharge from the two plants of about 60,000,000 gallons or 183.6 acre-feet, at a total cost for fuel, lubricating oil, and labor of $1,927, or about $3.25 per 1,000 gallons. Thus the average cost was

$10.49 per acre-foot of water delivered. This does not cover interest on cost of plant. The area irrigated was 125 acres, planted to citrus fruit trees, and Mr. R. C. Allen, manager of the company, states that the trees were given more water per acre than they had ever before received, even when the Sweetwater Reservoir was full.

The fine texture of the sand surrounding the pumping plant at Linwood Grove proved a serious bar to the development of water, as the passage of water through the sand was extremely slow, and the 76 wells were unable to yield as much as the pumps provided could lift. It became desirable and necessary, therefore, to provide more water to keep the pumps properly occupied, and an auxiliary plant was put in 3,000 feet higher up the valley. Here the development consists of forty 2-inch wells, reaching to a depth of 50 feet from the surface, the suction pipe connecting with all the wells being laid in a trench excavated from 10 to 15 feet in depth. The wells are arranged in pairs along the suction pipe, which is about 1,000 feet in length, and are spaced 50 feet apart, lengthwise of the pipe. The parallel row of wells, 30 feet from the suction pipe, is reached by branch suction pipes, 2 inches in diameter, lying in trenches cut at right angles to the main, which is 8 inches in diameter. These wells are thus all coupled together and connected to a 5-inch centrifugal Krogh pump, driven by a 22-horsepower gasoline engine, which lifts the water about 30 feet, including suction, and delivers it to a 12-inch pipe, lying on the surface, by which the water is conveyed by gravity to the Linwood plant, where it is lifted again and forced into the mains against a head of about 140 feet. This plant develops about 75 miner's inches, and was particularly useful last year, in the fall, when the other plants were beginning to give down somewhat in their yield. It has been entirely reconstructed this year, and the suction pipe lowered to the depths mentioned.

With the resumption of the obligation to continue pumping an irrigation supply throughout the irrigation season of 1900 came the necessity of more thoroughly exploiting the subterranean reservoir of the Lower Sweetwater Valley, between the dam and the mouth of the river. A plant was erected and installed April 29, 1900, at Bonita, where 42 wells were sunk to a uniform depth of 50 feet below the surface. These are 2-inch wells, arranged after the plan of the Linwood auxiliary plant, in pairs every 50 feet on the line of the suction main. One of each pair is at the main and the other 30 feet distant, at right angles. The suction pipe is placed in a trench from 5 to 8 feet beneath the surface. This plant differs from the others in that it has two 6-inch centrifugal pumps in tandem, pumping the water to and through the 30-inch main pipe against a force and suction head of 140 feet. In May the water not directly used was being forced back through the Sweetwater Dam, the gate being left wide open, into the reservoir, where it was being stored for use a little later on. The pump nearest the suction is driven by a 22-horsepower Fairbanks & Morse gasoline engine while the other pump is actuated by the same class of engine, having 28 horsepower. The water developed at this point with the plant described was about 74 miner's inches.

One or two additional plants will probably be erected and installed before the irrigation season is over. A deep test well is being bored at National avenue, and tests are being made at other points. Additional wells are also being bored at the Sunnyside plant.

The following table is a summary of the various pumping developments described in the foregoing pages:

Pumping plants in Sweetwater Valley installed in 1898, 1899, and 1900.

Serial No.	Date of installation.	Location.	Number of wells.	Diameter of wells.	Volume of water reported as developed on first test.	Owner.
				Inches.	*Miner's inches.*	
1	Sept. —, 1898	Quarter section 111	7	2	7	S. D. Land and Town Co.
2	Oct. —, 1898	Quarter section 85	8	2	10	Do.
3	Dec. 10, 1898	Quarter section 31	14	2	15	Do.
4	May 24, 1899	.....do	32	3	100	Do.
5	June 9, 1899	Quarter section 98	75	3	400	Do.
6	May —, 1899	Quarter section 47	14 5	2 3	33	Do.
7	.....do	A, 1 mile above dam	10	72 by 72	25	Do.
8	.....do	B, 1½ miles above dam	10	72 by 72	25	Do.
9	June —, 1899	Bonita schoolhouse	(*a*)	....	15	Sweetwater Fruit Co.
10	.....do	Bonita store	(*a*)	....	15	Do.
11	Aug. —, 1899	Linwood auxiliary	40	2	75	S. D. Land and Town Co.
12	Apr. —, 1900	Bonita	42	2	74	Do.
		Total	257	....	794	

a Sump.

The first three of these plants are not now in existence, or at least they have been substituted by some one of the other nine plants. The first two, as heretofore explained, were experimental and tentative, and of a very temporary character. Most of the others, with the exception of those in the reservoir, are well housed, and two of them are in the nature of permanent pumping works, first-class in all their appointments.

The plants which furnished the main supply of the San Diego Land and Town Company last year are numbered 4, 5, 6, 8, and 11 in the table. Number 11 was added quite late in the season. The test yield of the five plants was 625 miner's inches, but the wells did not long maintain the large yield shown at the time of their test, and, as nearly as can be ascertained, the net output for the season averaged only about 235 miner's inches. The pump records showed a total volume pumped for the season of 610,575,500 gallons, from which 25 per cent was deducted for probable slip in pumps, making the estimated actual delivery 457,931,600 gallons. As pumping was fairly continuous from June 1 to November 20, the time of actual pumping is reckoned at about one hundred and fifty days, making the delivery average 3,055,000 gallons per day, equal to 235 miner's inches measured under 4-inch pressure. The plane of saturation in the lower valley below the dam was lowered from 5 to 25 feet in the vicinity of the pumping plants as the result of this pumping. The total estimated volume pumped was equal to 1,405 acre-feet, or 6.25 per cent of the maximum capacity of the reservoir.

The writer is under special obligations to Mr. H. N. Savage, chief engineer of the San Diego Land and Town Company, for the data used in this report, which had been compiled by him for publication elsewhere, but was cheerfully contributed for use in this connection. He also acknowledges his indebtedness to Mr. John E. Boal, general manager, for information contributed and attention shown.

The cost of pumping plants erected in 1899 was $27,000, and about $10,000 was expended or to be expended on additional plants in the current year of 1900. The cost of pumping, including interest on machinery, depreciation, etc., was estimated at 3.5 cents per 1,000 gallons, which the farmers and fruit growers agreed to pay, in addition to the standard rates, in order to tide over the emergency without serious loss of fruit crop or injury to the orchards. The extra rates collected, however, did not quite cover the cost at the close of the year 1899, and in the current year, 1900, the rates were raised to 6.5 cents per 1,000 gallons to cover the cost of additional development for the season.

The general results of irrigation by the installed emergency pumping system have been quite gratifying in the main. The orchards have not died or suffered severely, and in fact have continued to bear heavily, although severely pruned to enable them to endure the drought. A number of orchardists and landowners, besides the Sweetwater Fruit Company, have dug or bored wells, developed water, and installed independent pumping plants, withdrawing their lands from the company's system for the time being.

Considering the limited area of water-bearing gravel and sand beds capable of storing water beneath the surface in its voids, the exceedingly fine texture of the sand in the greater part of the valley and the slow percolation to the wells through it, the results achieved in overcoming the unfavorable conditions imposed by nature are quite remarkable, and reflect credit on the company and its engineer, manager, and other officers.

RIPARIAN RIGHTS.

The application of the English common-law doctrine of riparian rights to any of the streams of arid America is a misfortune which most Western States and Territories, except California, have avoided. The application of this doctrine to California was made by a bare majority of one of the supreme court of the State in the famous decision rendered in 1881 in the case of Lux *v.* Haggin. Always inapplicable in a dry country where irrigation is required, it is particularly so when applied to streams of an intermittent character which can not be utilized without storage reservoirs.

The attempt to interfere with works of public necessity and importance by the assertion of this doctrine, after the expenditure of large sums of money, will always be made as long as the pernicious doctrine is adhered to in this State. The courts have been asked to order the removal or destruction of two large dams in San Diego County to satisfy riparian rights—viz, the Sweetwater and Lower Otay dams—and that the litigants did not succeed in accomplishing their purpose in either case was not due to any lack of destructive power in the law.

The first case of this kind was a suit in equity in the circuit court of the United States, ninth judicial circuit, southern district of California, and was entitled William Doyle *v.* The San Diego Land and Town Company, William G. Dickinson, J. D.

Schuyler, Frank A. Kimball, and Warren C. Kimball. Doyle was the owner of a tract of 51.38 acres of land that bordered on the Sweetwater stream bed for about 858 feet, nearly 2 miles below the Sweetwater Dam, and in the spring of 1889, a year after the dam was completed, he brought the action, alleging that Sweetwater River was a "nonnavigable, natural, and permanent water course or stream;" that his land is riparian to the stream; that the company's dam was built in such a way and so affixed to and embedded in the bed rock as to permanently obstruct the natural flow of the waters of said river through and by the plaintiff's lands; that the company had not condemned the plaintiff's riparian rights, and that it was intended to divert the waters of the stream to lands chiefly owned by itself, not riparian to the stream, under pretense that it is in charge of a public use; that the plaintiff's well, located 400 feet from the river, from which he was accustomed to pump water for irrigation, would become dry and had already failed to such an extent as to cause him to lose about one-half his usual orange and lemon crop, etc. He therefore asked for an injunction against the continuance of the obstruction to the natural flow of Sweetwater River. In other words, he wanted the dam destroyed. This dangerous action was defeated only by the discovery and production by defendants of a deed by which F. A. and W. C. Kimball, owners of the Rancho de la Nacion, on the 9th day of June, 1869, conveyed all riparian rights and rights to water flowing in Sweetwater River to the Kimball Brothers Water Company, a corporation, by whom these rights were in turn transferred to Lucius G. Pratt, trustee of The San Diego Land and Town Company. This antedated the sale or deed of any of the lands within the Rancho de la Nacion, including the lands of Doyle, and, therefore, as the defendant corporation owned the riparian rights which the plaintiff Doyle relied upon to win his case, he was nonsuited.

The other similar case has recently occurred, and was decided in 1899 in the superior court of San Diego County in favor of the defendant corporation, the Southern California Mountain Water Company. This company is owner of the Lower Otay Dam, located on Otay Creek, the next adjoining stream parallel to the Sweetwater on the south. This and the Sweetwater Dam are but 5 miles apart. The case is an interesting one as illustrating the dangerous possibilities which riparian rights, held in adverse ownership, may possess in threatening the destruction of storage reservoirs. The Otay is more "flashy" and uncertain in its flow than the Sweetwater, and though it sometimes carries a large flood flow at other periods, it may not flow at all for several years at a time. It was therefore to be expected that, as it was practically useless without storage, it would be the last place in which the riparian-right doctrine would be asserted to impede or destroy an enterprise of such great public utility and necessity as that of an impounding reservoir. The action was filed April 9, 1899, and was entitled Michael Bauers et al. *v.* Southern California Mountain Water Company, Joseph A. Flint, and E. S. Babcock, and bears the number 10840 in the court record of San Diego County. The plaintiffs were 17 in number, owning lands riparian to the creek, beginning about 5 miles below the dam and extending for 4 miles farther, to and beyond the town of Otay. The complaint alleges their riparian rights and the great damage and injury accrued and to accrue from the obstruction of the flow of the water, and asked judgment against the defendants that the dam be removed, and the defendants be enjoined forever from obstructing and diverting the natural and full flow of said water in said river. The attorneys for the plaintiffs failed to offer proof that the dam was water-tight in its connection with the bed rock of the stream, and therefore failed to prove that the dam obstructed the natural flow of the stream. It was chiefly on this ground that judgment was rendered for the defendants by Judge J. W. Hughes, from whose findings the following notes have been extracted:

(1) That Otay Creek has flowed during a portion of each year, except during years of extraordinary drought; that the flow of the water varies from none at all to a flow of short intervals, usually during the months of January and February, and depends entirely upon the frequency and extent of the local rainfall.

* * * * * * *

(16) That none of the lands of the plaintiffs, described in findings 2 to 15, are irrigated by said Otay Creek, except during a short period in the wet season and immediately following heavy rains; that wells have been dug in the bottom of said river bed, ranging in depth from 14 to 25 feet, from which some of the plaintiffs obtain water for domestic and other uses; that said wells are supplied by the waters which percolate through the soil and formation underlying the bed of said river and said Otay Valley, which is of a porous nature; that during the past two years, owing to extraordinary drought, some of said wells have not afforded the supply of water drawn therefrom in other and former years; that said river does not now and never has afforded water for household and domestic purposes or for irrigating plaintiffs' lands during the irrigation season, but during the time mentioned in the complaint the supply of water used by plaintiffs was secured solely and alone by means of said wells, which is the only source of supply, except the Otay Reservoir, 5 or 9 miles distant from the lands.

* * * * * * *

(19) On June 15, 1893, J. A. Flint posted a notice appropriating "5,000 miner's inches of water, and in seasons of freshet or high water the whole of the water here flowing to be here stored in a reservoir;" that within sixty days the said Joseph A. Flint commenced erection of the dam mentioned in said notice, so as to store and impound the amount of water appropriated, and he and his successors have since diligently and uninterruptedly prosecuted the work from said date to the date of this action, and have expended upward of $300,000 in the work. The Southern California Mountain Water Company acquired these rights so appropriated from J. A. Flint; that since 1893 the dam has impounded all the water flowing down said stream, except during a short time in January, 1895, when the flood waters ran over said dam at its then height; that the claim to own all the waters of Otay Creek for more than four years prior to the commencement of this action has been continuous, open, notorious, uninterrupted, and adverse to these plaintiffs; * * * that said dam is constructed above plaintiffs' lands, but does not obstruct other than flood waters, which if not obstructed would reach San Diego Bay at a distance of about 15 miles; that said obstruction has not deprived and will not deprive plaintiffs of the use of water for any purposes, or cause any injury or damage to any or either of them.

The following findings asked for by the defendants were denied:

That the defendant, the Southern California Mountain Water Company, has a prescriptive right to maintain the dam described in the pleadings herein, and impound in said reservoir and divert the waters of said Otay Creek, to the extent and in accordance with said notice of appropriation.

That by reason of their failure to protest or object to the construction of the said dam by the Southern California Mountain Water Company until after its completion at a cost of over $300,000, plaintiffs are estopped from maintaining this action against the Southern California Mountain Water Company for the removal of said dam.

The fact that these two findings were not allowed or sustained, and that the case was practically decided on a technicality, illustrates the urgent necessity that exists for a change in the application of the doctrine of riparian rights to intermittent streams or torrents, before they can be developed and utilized for irrigation.

In both these cases cited the dams had in reality wrought no injury to the lands of plaintiffs seeking the destruction or removal of the dams. In the Sweetwater case the lands of plaintiff Doyle are to-day supplying the greater portion of the water pumped into the Sweetwater distributing system by the San Diego Land and Town Company, even though the dam has been built for thirteen years, and during the last five years practically no water has passed it to the tract in question.

Until some change in this respect is made in the laws it will not be safe or prudent for parties contemplating the erection of storage dams to begin work before they have secured a relinquishment of all riparian rights on the stream below them. This safeguard is one which is not uncommonly resorted to, although it is slow and expensive. The San Diego Land and Town Company, holding the title to all the riparian rights from the upper end of its reservoir to the mouth of the Sweetwater, is no longer concerned with adverse riparian rights, and fears no further attempts at interference.

RIGHTS TO WATER FOR MINING, POWER, AND DOMESTIC USES.

Under this, the third, heading of the letter of instructions issued for the guidance of the investigators, there is little to be said applicable to Sweetwater River. There is no mining within the limits of the watershed, and consequently no water rights for mining exist on the stream. Neither are there any valid rights for power, except such as could be developed by the San Diego Land and Town Company at the Sweetwater Dam and on its system of distribution. Water is sold and used for power to operate one small mill. The community under the Sweetwater system enjoys its domestic water under the same system as other cities, delivered as needed, and have acquired prescriptive rights to the continued enjoyment of it in the future as in the past. All along the valley of the Sweetwater above the reservoir the right of residents to use what water they require for domestic purposes is unquestioned.

THE METHODS BY WHICH THE AMOUNT AND CHARACTER OF WATER RIGHTS ARE DETERMINED.

PRIMARY WATER RIGHTS.

There is absolutely no method discoverable by the writer by which the amount of valid water rights obtained by appropriation from Sweetwater River can be absolutely determined. This question has been discussed in the notes on the filings, and it has seemed to the writer that no other method than a formal judicial inquiry is competent to make the determination of the nature, extent, and volume of the established rights. The only records are those already described, viz, six books of miscellaneous records and three books of water-claim records, but one of which is indexed in a way to facilitate a search for the information sought. The books are accessible enough, as all county records are, and may be seen every legal business day of the year between the hours of 9 a. m. and 5 p. m. But when placed in one's hands there is nothing definite about them which will enlighten the investigator as to which of the jumble of claims is valid and constitutes an established right and which does not.

If, for example, any corporation or individual wished to consider the matter of constructing a dam and reservoir at any higher site on the stream above the present Sweetwater Dam, they would be unable to know or ascertain by any records in existence anywhere how much water was already owned by other parties and how much they would have to permit to pass by their proposed works to satisfy lower appropriators before they could begin to store water themselves; whether they would have to measure out a certain number of "inches" claimed by certain recorded notices, or permit the entire stream to pass by them until a certain body of water sufficient to fill the lower reservoir had gone down. These vague and uncertain conditions are sufficient to cause any investor to pause and hesitate before entering upon any enterprise involving so many possibilities for litigation.

SECONDARY WATER RIGHTS.

There are four varieties of claims of water rights under the Sweetwater Dam distributing system, subject to the adjudication of the courts upon their validity, which I have designated "secondary water rights," as distinguished from those drawing directly from the stream, or primary rights. These are defined by Mr. A. Haines, an attorney residing at Chula Vista, who has been employed in all the litigation against the company, as follows:

> First. Those rights arising in cases where the San Diego Land and Town Company, having constructed its system and laid its pipes, mains, and laterals, conveyed land as "irrigated land," without mention of water in the conveyance. The validity of this class of water rights depends on how the question of implied grant is resolved.
>
> Second. Those cases where, in the earlier history of the company, it voluntarily connected lands not bought of it with its distributing system and furnished water to such lands. The water rights of this class depend upon the construction of section 552 of the civil code, which is as follows:
>
> "Sec. 552. Whenever any corporation, organized under the laws of this State, furnishes water to irrigate lands which said corporation has sold, the right to the flow and use of said water is and shall remain a perpetual easement to the land so sold, at such rates and terms as may be established by said corporation in pursuance of law. And whenever any person who is cultivating land on the line and within the flow of any ditch owned by such corporation, has been furnished water by it with which to irrigate his land, such person shall be entitled to the continued use of such water, upon the same terms as those who have purchased their land of the corporation."
>
> Third. The third class of water rights consists of those rights which the corporation created by express contracts in writing for sale of land, together with one acre-foot of water per annum per acre, delivered at the highest exterior point of the land, for a price for land and water in solido, and subject to such further annual rate as the corporation had the right to establish, pursuant to law.
>
> Fourth. The fourth class of water rights are those created by express conveyance of water rights to the amount of one acre-foot per acre per annum to land not bought of the company, subject to such annual rates as the corporation should establish according to law. This class of rights dates from the year 1892, as well as those of the third-class. These water rights were at first sold for $50 per acre, and later they were raised to $100 per acre. Water rights of this class for about 200 acres were thus sold.

The records in the recorder's office of San Diego County show nothing specifically respecting water rights as to the first two classes, but they do show record of the contracts of the third and fourth classes, although it requires a searcher of records to be able to find them, and they are scattered throughout the numerous volumes of deeds and contracts.

LITIGATION OVER WATER RIGHTS, ITS CAUSES, COST, AND INFLUENCE ON IRRIGATION DEVELOPMENT, AND THE PRINCIPLES ESTABLISHED BY THE DECISIONS RENDERED.

There has been no litigation, as far as I have been able to ascertain, between rival appropriators of the Sweetwater River waters. As heretofore explained, the San Diego Land and Town Company is the owner of the only storage reservoir on the stream, and there has never been any contest or question of the right of the corporation to receive and impound all the natural run off of the stream, and none of the local diversions that have been or are likely to be made for irrigating lands riparian to the stream above the reservoir can possibly affect in any appreciable way the supply of the Sweetwater Dam, and consequently the corporation controlling that supply has no motive for questioning or attempting to interfere with such diversions, abstractions, or appropriations. Any lands irrigated in the watershed above the Sweetwater Dam must contribute a portion, at least, of the water so applied to the underflow of the river, and so, in a measure, return to the reservoir below. The Sweetwater Fruit Company, whose developments below the dam on their lands riparian to the stream bed have already been mentioned, has been uneasy for some time lest the neighboring well and pump developments of the San Diego Land and Town Company should diminish their supply, and have threatened suit, although probably deterred by the decision in the Doyle riparian case before mentioned.

THE NATIONAL CITY WATER-RATE CASE.

There has been an abundance of costly litigation, however, over the secondary water rights under the San Diego Land and Town Company's system, which began in an action brought by the San Diego Land and Town Company against the city of National City to set aside an ordinance of the board of trustees, passed February 21, 1895, fixing water rates for all uses. The complaint of the company was that the irrigation rate of $4 per acre per annum, fixed by the city ordinance, was so low as to tend to deprive the corporation of its property without due process of law; also, that the ordinance made no provision permitting the corporation to exact payment for a water right, of $100 per acre, claimed by it in cases where new consumers for irrigation desired to be connected with its system.

This cause was decided against the corporation by Judge Ross, of the circuit court for the southern district of California, the decision being found in 74 Federal Reporter, page 79. The decree of the court created no small amount of consternation in California, because it held that water companies, organized to distribute and sell water under the laws of the State from the public streams, had no such property as a "water right" which could be sold, and which they could require consumers to buy as a condition prior to the company's consenting to supply them with water. The following language is extracted from the decision referring to this point:

> One of the objects of the present suit is to obtain a decree establishing the validity of that claim of the complainant to exact a sum of money, in addition to an annual charge, as a condition on which alone the complainant will furnish consumers with water for irrigation purposes, other than those to whom it had furnished it for such purposes, prior to December 18, 1892, and the contest that arose between the consumers and the company over this charge for a so-called "water right," and the refusal of the municipal authorities of National City to allow that charge in respect to acreage property

> within the city limits, is one of the principal causes of the present suit. It does not change the essence of the thing for which the complainant demands a sum of money to call it a water right, or to say, as it does, that the charge is imposed for the purpose of reimbursing complainant in part for the outlay to which it has been subjected. It is demanding a sum of money for doing what the constitution and laws of California authorized it to do, to appropriate water within its limits, conferring upon it the great power of eminent domain and the franchise to distribute and sell the water so appropriated, not only to those needing it for purposes of irrigation, but also to the cities and towns and their inhabitants within its flow, for which it was given the right to charge rates to be established by law, and nothing else. No authority can anywhere be found for any charge for the so-called water rights. The State permitted the water in question to be appropriated for distribution and sale for the purposes of irrigation, and for domestic and other beneficial uses; conferring upon the appropriator the great powers mentioned and compensating it for its outlay by the fixed annual rates.

This case was appealed to the United States Supreme Court, to whom it was submitted October 11, 1898, and by whom it was decided May 22, 1899. From the following syllabus the points of the decision can be obtained:

> (1) Formal notice as to the precise day upon which water rates will be fixed by ordinance need not be given to a company whose rates are thus fixed under the California constitution, which gives notice of the fact that ordinances will be passed annually in February, to take effect on the 1st of July then next.
>
> (2) An opportunity to be heard upon the question of water rates fixed by ordinance is not denied where such rates are fully considered in conference between the officers of the corporation whose rates are fixed and the municipal authorities, and such officers are heard, although they are not allowed to be present at the final meeting when the ordinance is passed.
>
> (3) Judicial interference should never occur with the collection of rates established under legislative sanction unless the case presents clearly and beyond all doubt such a flagrant attack upon the rights of property, under the guise of regulations, as to compel the court to say that the rates prescribed will necessarily have the effect to deny just compensation for private property taken for public use.
>
> (4) The reasonable value of property, rather than its original cost, is to be taken as the basis of calculation in determining whether rates fixed under legislative authority constitute a fair compensation for the use of the property, so that the owners are not deprived of their property without due process of law.
>
> (5) The losses from distribution of water to consumers outside of the city are not to be considered in fixing by ordinance the rates for consumers within the city.

The United States Supreme Court makes no decision of the question as to whether or not, in fixing the annual rates to be charged, the body authorized to fix them can take into account the amount that has been received by the company for water rights, or as to whether the company could demand a sum of money for such water rights, or "so-called water rights," as Judge Ross designated them. Referring to this, the United States Supreme Court says (174 U. S., 739):

> * * * The present case does not require or admit of a decree declaring that the appellant may, in addition to the rates established by the ordinance, charge for what is called a "water right" as defined by it. It will be time enough to decide such a point when a case actually arises between the appellant and some person or corporation involving the question whether the former may require, as a condition of its furnishing water within the limits of the city on the terms prescribed by the defendant's ordinance, that it be also paid for what is called a water right.

WATER-RATE CASE OF LANNING v. OSBORNE ET AL.

The next cause to be brought before the courts on the subject of water rights and water rates was the result of the attempt of the San Diego Land and Town Company to collect, from and after January 1, 1896, the sum of $7 per acre per annum for water rental, instead of $3.50, the rate previously prevailing. The case was entitled C. D. Lanning, receiver of the company, *v.* H. C. Osborne and some 200 others, who were irrigators of land outside of National City.

The complaint showed that the corporation, in opening its service in 1888, in addition to the rates for domestic uses and the like, established an irrigation rate of $3.50 per acre per annum, and alleged that this was too low to furnish any net revenue above the expenses of maintenance and operation, and insufficient to maintain and operate the system. The corporation claimed the right to an increased rate of $7 per acre per annum for irrigation alone, in order to pay cost of operation and maintenance and pay the company a reasonable interest on its investment. The defendants denied the right of the corporation to increase the rate from $3.50 to $7 per acre, on the ground that the company sold its lands to a large number of the defendants as irrigated lands, and under the representation that the rates would be $3.50 per acre per annum; and all the defendants claimed that the corporation was bound by its rate of $3.50 per acre per annum, so established in 1888 and collected up to January 1, 1896, and they insisted that the claim of the corporation to increase its rate for the purpose of increasing its net revenue was in violation of their vested rights. To the claim of the corporation that it had the right to increase the rate in its discretion, and that the only recourse the irrigators had was a resort to the board of supervisors, under the law of March 12, 1885, to fix rates, the defendants objected that the board of supervisors was compelled by such act to allow a rate not only for maintenance and operation, but also for net revenue, at not less than 6 per cent and not more than 18 per cent on the value of the system. The circuit court of the southern district of California, before whom the cause was heard, held that the only remedy of the defendants was to go to the board of supervisors; threw doubt upon the validity of the water rights held by the defendants, and rendered judgment against them, authorizing the corporation to collect the $7 rate from the time when claimed by the company, January 1, 1896, until the board of supervisors should fix rates. The syllabus of the case, as published in 76 Federal Reporter, page 319, is as follows:

> (1) No corporation appropriating water under and by virtue of the constitution and laws of California for sale, rental or distribution has the right to exact any sum of money or other thing in addition to the legally established rates as a condition upon which it will furnish to consumers water so appropriated.
>
> (2) Since by the civil code of California a consumer whose right to demand a supply of water from a company has once vested is protected from the injury of having his supply cut off, he may prevent by injunction, if need be, the distributor from disposing of it to others beyond the capacity of the system.
>
> (3) Should the rates fixed by the county board of supervisors for the sale, rental, or distribution of water appropriated for these purposes, as provided by acts of California, March 12, 1885, be unreasonable, a person aggrieved may have the rates annulled by the courts, and the question be again remitted to the board.
>
> (4) Where water is appropriated and furnished by a public or quasi-public corporation, the water being charged with a public use, the rates must be established in pursuance of law, and no attempt to fix them by private contract with consumers is of any validity.
>
> (5) Since the act of March 12, 1885, provides that, in case of failure of the board of supervisors to establish rates for furnishing water as provided in the act, the rates established by the company shall control, the latter is not divested of the power to fix rates by the fact that before the passage of the act it contracted to furnish water at a lower rate, the persons with whom it so contracted being chargeable with notice that the constitution conferred power upon the legislature to prescribe the manner in which such rates should be established.

This cause was also appealed to Washington, and on the 14th day of May, 1900, the United States Supreme Court rendered its decision, affirming the decree of the circuit court regarding annual rates, but again made no decision on the subject of the power of the corporation to sell a water right.

APPEAL FROM ORDINANCE OF SUPERVISORS FIXING RATES.

Pending the appeal of this case the board of supervisors of San Diego County, in response to the application of taxpayers and at the instigation of water takers under the Sweetwater system, appointed a public hearing, received evidence, and after a long investigation passed an ordinance fixing the domestic rates the same as they had been in the past, and the same as under the ordinance held valid in National City, and the irrigation rate was fixed at $3.50 per acre per annum, as in their judgment sufficient to give the company its legal rights, the same to take effect November 16, 1897. From this ordinance the company appealed to the United States circuit court, in case No. 768, entitled San Diego Land and Town Company *v.* James A. Jasper et al. Evidence in this case has been taken, argument was heard June 25, and the case is pending a decision.

THE NATIONAL CITY CASE, ESTABLISHING THAT DOMESTIC USE IS NOT SUPERIOR TO IRRIGATION.

About September, 1898, a suit was brought in the superior court of San Diego County by the city of National City against the San Diego Land and Town Company, which was not resisted by the corporation. It was brought to restrain the corporation by injunction from furnishing any water from the small supply then left in the reservoir for any other uses than domestic. The theory of the case was that, as the water supply in the reservoir was nearly exhausted, it was needed for domestic use, and such use should take preference over uses for irrigation. The injunction was issued against the company by its virtual consent, whereupon it notified all the irrigators to stop irrigating, pursuant to the injunction. The irrigators submitted to this until sometime in December, 1898, when, in view of the fact that their lemon and especially their orange crop was suffering for water, a number of them notified the company that they proposed to turn on the water for irrigation unless they were made parties defendant and also enjoined. Thereupon these irrigators were made defendants to the injunction suit, a hearing was had and the injunction was dissolved, the court holding that the domestic uses had no superiority over those for irrigation. This case was not appealed.

THE SHARPE CASE.

In May, 1897, James M. Sharpe brought an action against the San Diego Land and Town Company, in the United States circuit court for the southern district of California, in which he alleged that he was a landowner under the system; that since 1892 the corporation had been supplying him with water for irrigation, and that in 1897 the corporation had shut off his water supply, although he had tendered its established rate, which was refused by the company, the refusal being accompanied by the statement that such water supply would not be continued unless Sharpe would enter into a written contract to pay the sum of $11.50 per acre annually for the land irrigated, and also enter into further stipulations relinquishing all right and benefit after two years, under section 552 of the code of civil procedure.

The defense of the corporation was that the water had been furnished under a contract dated March 26, 1892, which had expired, the term having been for five years, and that such contract contained a proviso by which Sharpe had expressly waived and relinquished all right and benefit under section 552 of the code of civil procedure, after five-year term of his contract, and had also stipulated that all duty, liability, and obligation of the company to furnish water to his tract of land should, at the end of five years, cease as absolutely as if the contract had never been made.

The court granted an injunction against the company restraining it "from shutting off the flow and supply of water from said company's water system from the petitioner's land described, and from interfering with the use and flow of said supply of water for irrigation of the same so long as the petitioner shall pay the legally established rates therefor."

This decision was affirmed by the United States circuit court of appeals for the ninth circuit, the decree of which court was final. This case illustrates the danger that may lie to a water company in making a temporary contract for the delivery of water for a limited time. Sharpe's land was located in the Otay Valley quite a distance beyond the limits of the district supplied with distributing pipes by the San Diego Land and Town Company. He expected to get his permanent supply of water from Lower Otay Reservoir, or from another water system whose works were supposed to be under construction; but for temporary purposes, and to get his trees started before the new system of irrigation could be finished, he persuaded the manager of the San Diego Land and Town Company to permit him to connect with the Sweetwater system temporarily, agreeing to disconnect at the end of five years. This was done under protest of the engineer of the system, as the connection was one exceedingly difficult to maintain, and involving extra expense in getting a water supply to the lands when the supply in the reservoir became low. As the other systems were never completed Sharpe could not get water anywhere else, and at the expiration of the time appealed to the courts to save him from the consequences of his own express contract, and prevent him from being deprived of water, which they did.

THE HALE WATER-RIGHT CASE.

Pending the case of Lanning *v.* Osborne in the United States circuit court, before Judge Ross, and after he had rendered an opinion in the progress of that cause, holding that a corporation could make no contracts for sale of water rights, one G. W. Hale, having paid the San Diego Land and Town Company $100 per acre on 15 acres of land under the company's system for a water right, in order that he might procure water for the irrigation of the same, and having taken from the corporation a contract, under which they agreed to refund to him the $1,500 paid if it was decided that the corporation could not legally sell or exact pay for a water right, assigned his claim for rebate to the Bank of National City. Subsequently the bank brought suit against the company, before Judge Ross in the United States circuit court, for the refunding of this money, with interest, and, after trial, recovered judgment, which was paid. The case was not appealed.

COST OF WATER LITIGATION.

The cost of litigation in the various disputes over water between the San Diego Land and Town Company and the irrigators has been estimated as in excess of $20,000, and there is still much uncertainty regarding respective rights.

The effect of this litigation on irrigation development and the values of land has been very disastrous.

RIGHTS FOR STORAGE AND UNDERGROUND WATERS.

On this subject but little can be said as applicable to the Sweetwater system which is not general to the whole State. The only recognized rights to storage and underground waters are those which are granted to all persons under the water appropriation law of the State, and can not be distinguished from the rights granted by the same act to the surface flow of the streams. The use of underground water on this watershed is too small in volume to affect the discharge of the stream appreciably or at all.

NATURE OF AN APPROPRIATION OF WATER.

I think it is universally held throughout California that the ditch or reservoir builder is the appropriator of the water, and not the land itself. On this system no assertions of being actual appropriators of the water have been made by the landowners in all the litigation that has arisen, nor any allegations that the San Diego Land and Town Company is merely a common carrier for the people, as has been maintained in Colorado. There is some difference of opinion, however, as to whether or not the company owns the corpus of the water impounded in its reservoir, as distinguished from the "right of use" of the water of a flowing stream. It would seem to the writer as though they had seized, captured, and impounded the water, and owned it as absolutely as though they had put it into bottles, or in any other form by which it might be shipped away. They sell it by volume and measure it out in regular units of measurement, so many thousands of gallons being apportioned to each acre, and no one has any more right to intrude upon the reservoir site to take any of the water stored therein, even though the reservoir may be a part of the stream, than they would have to enter a warehouse and take the merchandise stored there. To the extent of the capacity of the reservoir the company is absolute owner of all water which flows in the stream down to the margin of the reservoir.

There should be a modification in the appropriation laws when applied to reservoirs in the way of defining the appropriation made for them, and instead of expressing such appropriation in miner's inches under a 4-inch pressure, as at present, the amount appropriated should bear some fixed relation to the capacity of the reservoir, and should either be a stated number of acre-feet per annum, or it should be expressed in reservoirfuls. Also, the capacity of the reservoir in acre-feet, or some other convenient unit, should be known and stated in the notice of appropriation.

RETURN SEEPAGE AND ITS EFFECT ON WATER RIGHTS.

The return water, or seepage, from irrigation along the Sweetwater Valley is manifest in but one case very conspicuously. When a certain alfalfa field of 40 acres in area at Bonnie Brae is irrigated sufficiently to maintain the crop in vigorous growth, there is a pronounced increase in the supply available at the pumping sumps of the Sweetwater Fruit Company, a mile or two below. This company has a frontage of about 3,000 feet on the stream bed, which enables it to develop water by pumping, as heretofore described.

The irrigation of land in the bottom above adds very decidedly to the value of the water rights of this company. The greater portion of the area irrigated under the Sweetwater system, however, is mesa land, from which there has as yet been no seepage water returning to the stream, as far as observed.

METHODS OF DISTRIBUTION AND DUTY OF WATER.

Water is distributed under the Sweetwater system exclusively in pipes under pressure. The irregular contour of the topography of the region renders this almost a necessity, but it has many advantages, and the irrigators under the system have all the water privileges enjoyed by the inhabitants of cities and towns, and equally good fire protection, especially on the lower levels. When the water is low in the reservoir, the higher lands near the maximum hydraulic grade line are supplied with much difficulty.

The pipe distributing system, as originally constructed, consisted of 5.64 miles of main conduit, 36 inches and 30 inches in diameter, reaching from the dam to Chula Vista; 1.54 miles of 24-inch pipe; 3.13 miles of 18-inch pipe; 6.80 miles of 12-inch pipe; 2.22 miles of 8-inch; 28.4 miles of 6-inch, and 9.6 miles of 4-inch pipe, a total of 58 miles, all wrought iron. Of this, 41 miles, or 70 per cent, is lap-welded pipe put together with lead joints. A second main, 24 inches in diameter, was laid in 1894, on the north side of Sweetwater Valley, from the dam to National City, to supply the high service chiefly. This line cost $65,000. Numerous extensions have subsequently been built, so that the system fully covers an area of more than 5,000 acres. The total outlay for the dam and distributing system has been $1,026,022.79, aside from the cost of pumping plants.

The duty of water has been discussed in previous pages in a general way. It has been demonstrated during the recent protracted droughts that with an annual allowance of 105,000 gallons per acre per annum, applied at intervals during the summer, the orchards thrive. Of course continuous cultivation is required at the same time. This meager apportionment, equal to 3.85 inches in average depth over the surface, is surely a minimum allowance. A cubic foot per second, flowing for two hundred days, which is the usual length of the irrigating season, would cover 1,234 acres to the depth represented by this allowance. In flush seasons, when water is abundant, the use of water reached as high as 1.5 to 2 feet depth of application, equal to a duty of 264 to 198 acres per cubic foot per second flowing for a period of two hundred days. The allowance of one foot in depth, which is generally satisfactory, and which the company ordinarily expects to deliver whenever it has water in its reservoir, is equivalent to a duty of 395 acres per cubic foot per second, flowing during two hundred days of irrigation.

WATER-RIGHT CONTRACTS, WATER RATES, ETC.

Although the Sweetwater system was completed in 1888, and irrigation begun in that year, no water-right contracts were sold prior to 1892, as up to the latter date the company gave little intelligent consideration to their plans for the apportionment of their supply. The following classes of rights are regarded by the company as identical:

First. Those belonging to parties who purchased land from the company and had a tacit right to water from the system, although no reference to water was made in the deeds.

Second. Those belonging to owners of land, not purchased of the company, who, by applying to the company, were allowed to take water without payment further than the same annual rates charged to all land owners.

Third. Those belonging to owners of land who, after 1892, purchased the water right for a lump sum—a price started at $50 per acre and later raised to $100 per acre.

The following form of contract was used for the third class of water rights:

WATER-RIGHT CONTRACT.

This agreement, made and entered into this —— day of ——, 189—, by and between the San Diego Land and Town Company, a corporation existing under and by virtue of the laws of the State of Kansas, and the owner of certain water and water rights and a system for the delivery of water to consumers, in the county of San Diego, State of California, party of the first part, and —— ——, of ——, county of ——, State of ——, party of the second part;

Witnesseth: That the party of the first part agrees to and does hereby sell to the party of the second part a water right to 1 acre-foot of water per acre per annum for each and every acre of the real estate hereinafter described, to be delivered through the pipes and flumes of the party of the first part at —— for the sum of —— dollars, payable as follows: —— —— *Provided*, the party of the first part may, at its option, change the place of delivery of said water so long as the same is near the highest point on the lands for which the water is delivered, and provided further, that the same shall be delivered under and in accordance with the rules and regulations established from time to time by the party of the first part.

Said water right is sold for the use of and to be appurtenant to the following-described real estate now owned by the party of the second part in the county of San Diego, State of California, to wit: (Here follows description of land) consisting of —— acres. And it is expressly understood and agreed that the water right hereby sold shall belong to said described real estate and be used thereon and not diverted therefrom or used on any other lands.

In consideration of the foregoing stipulations and agreements the party of the second part agrees and binds ——self, —— heirs, executors, and assigns, to pay the sum above specified promptly, as the same and each of them fall due; and that —— will in all things comply with and perform the terms and conditions of this agreement on —— part to be performed, and that —— —— and they will promptly pay all annual water rates and charges for the water to which —— —— is entitled under and by virtue of this agreement, at rates fixed by the party of the first part, as allowed by law, and at the times, in the manner, and according to the rules and regulations made and adopted by the party of the first part, the annual rental for the amount of water to which the party of the second part is entitled under this contract to be paid whether the same is used or not, and also to pay for all water used by —— —— on said land for domestic purposes at the rates fixed by the party of the first part and allowed by law.

It is further agreed that the amounts hereby agreed to be paid for said water right and for the rates for the water shall be a charge and lien upon the real estate above described, and run with and be binding thereon, in the hands of the party of the second part, —— heirs, executors, and assigns, in the same manner and to the same extent as if a mortgage were given to secure the payment thereof.

The payments above provided for, and each of them, must be made to the party of the first part at its office at National City, in the county of San Diego, State of California.

And it is expressly stipulated and agreed that time is of the essence of this contract, and in case of the party of the second part, —— heirs, executors, or assigns shall fail to make the payments aforesaid, or any of them, or any part thereof, at the times and place above specified, then this contract shall, at the option of the party of the first part, be and become entirely null and void, and the party of the first part shall have the right to shut off and cease to deliver said water; or the party of the first part may at its option, enforce this contract by action to collect the sums due, and the enforcement of its lien therefor upon said lands, and in case it so elects to enforce this contract the failure to pay any of the sums falling due for said water right or any part thereof, shall render the whole amount of all of the payments therefor immediately due and collectible.

It is further stipulated and agreed that no assignment of this contract shall be valid except the same be made with the conveyance of, and to the owners in fee simple of, said real estate, and that any person to whom this contract is assigned, or said real estate and water right conveyed, his or her heirs and assigns shall become personally liable to pay the amounts agreed by this contract to be paid.

And any assignment or conveyance of this contract or the water right herein sold, to any person not the owner in fee simple of said real estate, shall be absolutely void, and any such assignment or conveyance shall forfeit all rights under this contract; and the party of the first part may, immediately, shut off and cease to furnish water under this agreement.

In witness whereof the parties have hereunto set their hands and seals this —— day of ——, 18—.

This form of contract was satisfactory to all parties concerned, until its validity was brought in question by the decision of the United States circuit court, referred to in the chapter on litigation. Since that decision was rendered no further water rights have been sold.

The rates for the sale or delivery of water are fixed by the city council of National City, and specify in detail the various uses of domestic water supply and the rate for each, which are about the same as the average rates in cities and towns. In addition to these rates, the ordinance provides an irrigation rate, to be applied to all tracts over 2½ acres in area, of $3.50 per acre per annum, based on a maximum use of 350,000 gallons (1.07 acre-feet per acre), with meter rates of 1 cent per 1,000 gallons for water so used. The meter rates for domestic water are 30 cents per 1,000 gallons.

Practically the same rates are collected outside of National City, in the remainder of the system, although as heretofore stated the company has been endeavoring to enforce the collection of higher rates on the ground that the old rates did not afford any adequate return upon the capital invested. These higher rates are resisted by the consumers, and the United States circuit court and the United States Supreme Court sustain the company in the contention that they should have adequate rates, but leave the company in the hands of the supervisors, who have confirmed the old rates, which the company are again contesting in the courts in a suit to set aside the ordinance of the supervisors.

The application for water made to the company by the consumer is written out on blank forms, reciting the rate to be paid for each class of domestic service and for irrigation, describing the land and the location of the tap. This application constitutes a contract and a promise to pay the rate so designated quarterly in advance. The company also issues a book of rules and regulations governing the water supply, of which rule No. 1 states that "the following regulations shall be considered a part of the contract with every person who takes water," etc. These rules are 17 in number, and lay down certain stipulations regarding the mutual relations of the company and the consumer, which could not so well be expressed in the contract.

THE FIXING OF WATER RATES.

The constitution of California contains a provision requiring that water rates shall be fixed annually in the month of February of each year by the city councils or boards of trustees for cities and towns, or by the county boards of supervisors, for water systems that are not within corporate limits of cities or towns. This provision has worked a great hardship upon companies supplying water and caused them to suffer such loss from the construction of the law as to render it impossible for them to realize any profit. The effect has been to exclude capital from investment in the development of water systems, and to set up a constant war against capital invested in this very necessary class of public improvements, which is adverse to the general welfare of the State and seriously retards its growth.

The law would be a satisfactory one if a proper basis were established to bind and control those who adjudicate the matter, either the bodies who have the power to fix the rates or the courts who have the power to review the action of the city councils or county supervisors. It has been suggested that there should be a State board intrusted with judicial power for the fixing of water rates, to hear testimony in all cases, and decide as between the water purveyors and the consumers; this board to take cognizance of all local conditions and adopt some equitable basis of more or less uniform application. The first step to be settled by such a board would be the basis for determining the value of the plant. In arriving at the value of the plant, the courts have laid down the rule that the cost is but one element of the value. Other considerations must be taken into account, such as the value of the franchise for distributing a needed commodity, the strategic position which the plant occupies, and its importance to the community supplied by it. The board should determine how depreciation shall be allowed for and determine whether the rates should be sufficient to cover a sinking fund for the reproduction of the perishable parts of a plant within a given period, or whether the rates shall be increased from time to time sufficiently to raise funds for replacing worn-out portions of the plant at the time the expenditure is necessary, which latter method would result in a widely varying rate from year to year. The constitution fixes a very wide latitude of net income to which the water companies are entitled over and above operating expenses of from 6 per cent to 18 per cent per annum. This may have been intended by the framers of the constitution to provide for a fund to cover depreciation, but if this is the case it fails to do so satisfactorily. If a definite maximum rate of interest of 6 per cent were fixed in addition to depreciation and operating expenses, it would be reasonable and fair to all parties concerned. This would remove all possibility of controversy, and the board, after having determined the value of the plant and the probable ratio of depreciation, would then only have to decide what the reasonable expense of operation should be to determine the rates required.

Such a commission, or board of control, should have authority to decide in advance of the construction of an irrigation system dependent for its supply upon storage reservoirs, as to what would be a reasonable provision in the way of storage for dry seasons, and what proportion of the total capacity of the reservoir could safely be distributed for irrigation each year, and from this and other data they should determine the value of the water rights to be charged to the lands for irrigation service.

HEMET CREEK.

The stream issuing from Hemet Valley in the San Jacinto Mountains is locally known as Hemet Creek or South Fork of San Jacinto River. It drains an area above Hemet Dam of 66 square miles of rugged mountain watershed, from 4,300 to 9,000 feet in elevation, and has in ordinary seasons a minimum flow of about 200 miner's inches, or 4 cubic feet per second. The watershed is fairly well clothed with forest trees of pine and oak, and the mountain sides are generally covered with dense underbrush where the forest trees are not in evidence. The stream is the largest of the three principal tributaries that unite before issuing from the mountains to form San Jacinto River. The entire watershed area of the river above the mouth of the canyon is 143 square miles, and the proportion intercepted by the Hemet Dam is therefore 45 per cent of the whole. The San Jacinto is a typical southern California torrent, deserving of the name of river only at certain rare intervals when seasons of heavy rainfall produce a run off of such volume as to enable it to fill two large lakes which lie along its source, and which when filled finally overflow and seek an outlet to the sea by joining the Santa Ana River at Rincon, below South Riverside. The first of these lakes is located in the great San Jacinto Valley, about 15 miles northwest from the mouth of the canyon, and is a broad, shallow lagoon of large capacity. Before reaching this pond the river must traverse a broad, porous bed of sand and gravel which is capacious enough to swallow up a very considerable stream. In ordinary seasons the river does not reach all the way to the lagoon before being absorbed in these thirsty gravel beds. When the seasons are wetter the river may reach the lagoon and fill it partially or wholly. Any water overflowing the lagoon must then pass southwesterly across the San Jacinto Valley on a very flat slope, filling more gravel beds on the way, and thence through a rocky canyon to Elsinore Lake, a total distance of 25 miles in an air line from the lagoon, or about 40 miles by the channel. If the season is extremely wet the run off may suffice to fill the lake and overflow to the Santa Ana, a further distance of 25 miles, and thus make a continuous connection from the mountains to the sea; but this occurs at such rare intervals as to be phenomenal whenever it does happen.

The fluctuating character of the stream has rendered it of little value as a source of supply for irrigation, prior to the construction of the Hemet Dam in 1890–1895. The only diversions from the main river below the mouth of Hemet Creek, prior to the commencement of construction of the dam were an 8-inch steel pipe line, carrying water to the Florida tract, a ditch with a capacity of about 3 to 4 cubic feet per second supplying a farm nearest to the mouth of the canyon, and a few flood-water ditches down the stream above the lagoon for meadow irrigation, which received a precarious and uncertain supply.

No diversions had ever been made of Hemet Creek proper, the stream to which my inquiries were confined by my instructions, before the building of the dam. Hemet Valley above the dam is a frosty region where crops can not be profitably raised on account of climatic severity, and hence it is devoted to grazing. The outlet to the valley is a narrow, rocky gorge some 9 miles long, cut in granite, in which the stream plunges down a descent of 2,000 feet before uniting with Strawberry Fork. The masonry dam is at the head of this gorge, and water from the reservoir is released into the canyon and picked up again at its mouth in a flume, which conveys it down the main canyon 3.5 miles, to the San Jacinto Valley.

CLAIMS TO WATER ON HEMET CREEK.

All the filings which have ever been made to water in Hemet Creek were evidently made solely for the supply of a reservoir to be located at the site of the existing reservoir. The dam site was so narrow and so striking in its natural excellence as a location for a masonry dam that it attracted general notice, and various parties looked at it with a view to building a dam before the structure was finally decided upon by capitalists able to build it.

The filings shown by the records of San Diego County on this stream are enumerated as follows:

No. 1. November 8, 1884, Charles H. Thomas and L. M. Wilson filed a claim to "all the water of the San Jacinto River," at a point described as "6 miles westerly from Charles Thomas's house."

No. 2. July 24, 1885, G. D. Compton and James Kerr filed a claim to a reservoir site "about 4 miles westerly from Charles Thomas's residence," but they did not specify any definite amount of water claimed.

No. 3. December 20, 1885, Leon H. Taylor filed a claim to "2,000 inches, measured under a 4-inch pressure, for domestic and agricultural purposes," the point of diversion being "sec. 8, T. 6 S., R. 3 E., at west end of Hemet Valley."

No. 4. December 14, 1885, James S. Crain filed on a reservoir site at sec. 7, T. 6 S., R. 3 E., "said reservoir to be used for holding and storing water, and said water to be conveyed to San Jacinto and Pleasant valleys by means of pipes, flumes, and ditches, and to be used in irrigating lands in the above-named valleys, and for conveying wood, lumber, fence posts, and all kinds of building material to San Jacinto and Pleasant valleys, and also for mining, milling, manufacturing, and domestic purposes." No volume of water is specified.

No. 5. April 13, 1886, L. M. Wilson and James S. Crain filed on a reservoir site, located 3 miles west of filing No. 4 above. No volume of water is named in the filing.

No. 6. October 7, 1886, John McBride, James S. Rainey, and John S. Crain filed a notice relocating and claiming the location as a reservoir dam site, described as being "situated at the westerly end of Hemet Valley, and about 3.5 miles in a westerly direction from the residence of Charles Thomas." The volume of water claimed is "all of the surplus water at this point of location which can be held in reserve by a dam 50 feet high, or 75 feet high, or 100 feet high, or 110 feet high."

No. 7. December 7, 1886, James R. Cheathem filed on the reservoir dam site at the westerly end of Hemet Valley, "on account of all the previous locators having failed to comply with the laws governing the location and holding of reservoir dam sites."

No. 8. September 30, 1890, the Lake Hemet Water Company filed a notice claiming the water flowing to the extent of 200 inches, measured under a 4-inch pressure, at a point described as 500 feet northwesterly from the SE. corner of NE. ¼ sec. 8, T. 6 S., R. 3 E., which point is about 1.5 miles above the site of the Hemet Dam. From about this point the company subsequently built a ditch and flume leading to the dam, conveying about 100 inches of water, which was used for power during the building of the dam.

No. 9. September 30, 1890, the Lake Hemet Water Company filed a notice claiming 100 miner's inches of water flowing in Herke Creek, a tributary of Hemet Creek, the point of diversions as described being but 450 feet from the location of claim No. 8.

No. 10. June 30, 1891, the Lake Hemet Water Company filed a notice claiming "the water flowing in the San Jacinto River at the point of diversion, to wit, in the NW. ¼ of sec. 28, T. 5 S., R. 2 E., S. B. M., just above the mouth of Strawberry Fork, to the extent of 4,000 inches, measured under a 4-inch pressure, to be used for agriculture, domestic, mechanical, and mining purposes," etc.

These are all the claims to water of record in the recorder's office of San Diego County referring to Hemet Creek, and there are no claims on file in the records of

Riverside County claiming the waters of that stream. Riverside County was formed in 1895, and all the watershed area and the lands irrigated from the stream are now in that county, and while an enormous quantity of water has been filed upon from the stream below the junction of Hemet Creek, no filings have been made of the waters of that branch of the river.

The Hemet Dam successfully impounds all the waters that have come down to it since its completion in 1895, and therefore actually appropriates the water, although it will be observed by reading the list of filings that no claim to water for the reservoir itself has been made by the Lake Hemet Water Company, the owners of the dam, and their only filing for any amount anywhere approximating the capacity of the reservoir is for 4,000 inches, located at the diverting dam, 9 miles below the reservoir.

THE HEMET DAM.

This structure was planned by the writer for a possible height of 160 feet above the stream bed, and the profile built up to the height of 110 feet is of a section designed to carry the full ultimate height. At that level of 110 feet the thickness is 30 feet. An offset of 20 feet was here made, and the wall carried up to 122.5 feet, with a crest 10 feet wide. The height above lowest foundation is 135 feet; the thickness at base, 100 feet; top length, 246 feet; base length, 30 feet. It is arched upstream with a radius of 225.4 feet, and is built of granite rubble laid in Portland cement concrete, the contents being 31,105 cubic yards.

The capacity of the reservoir is as follows:

Capacity of Hemet Lake.

Height above base of dam.	Surface area.	Capacity.
Feet.	*Acres.*	*Acre-feet.*
40	2	33
*a*45	2.3	73
50	3	113
60	29	332
70	62	773
80	103	1,603
90	133	2,787
100	187	4,391
110	252	6,598
120	328	9,512
*b*122.5	365	10,500

a Lowest outlet. *b* Top of dam.

The reservoir has never been entirely filled since its completion to its present height, October 9, 1895, although when it had reached a height of 107 feet there came a flood, January 9, 1893, which filled the reservoir and poured over the top of the dam to a depth of several feet. The record of subsequent inflow and draft has been so imperfectly kept that no reliable estimate can be made of the actual run off from the watershed during the past five years. At the high elevation at which the reservoir and its watershed lie, the run off should be sufficient to fill the reservoir with certainty every year, as it requires but an average depth of run off of 3 inches over the watershed to do it. Inasmuch as the reservoir has not filled in any year since 1895, it is an evidence of the paucity of precipitation and the severity of the protracted drought which has prevailed in southern California in all that period.

THE IRRIGATED LANDS.

The Hemet Dam was built by the Lake Hemet Water Company for the sole purpose of supplying a tract of 7,000 acres belonging to the Hemet Land Company and the three or four individual stockholders. The water is conveyed to this tract from the diverting dam at the mouth of Hemet Creek, or South Fork, through 3.5 miles of flume, discharging at the mouth of the main canyon of the river into a box at the head of a 22-inch riveted steel pipe 2 miles long. This pipe carries the water across the channel of the river and out upon a mesa to a measuring box, which discharges into a masonry-lined open canal and flume 5 miles in length, that in turn empties into a 10-acre distributing reservoir. From this reservoir the distribution through the tract is made by small, lined ditches and flumes, of which there are more than 30 miles in all, covering the entire tract.

Water is also delivered under pressure from the reservoir to the town of Hemet, passing through a filtering or straining apparatus to clarify it and take out all vegetable matter. The tract is subdivided into smaller tracts of 5 to 20 acres, a considerable number of which have been sold to farmers residing upon them. These tracts are chiefly planted to deciduous fruits—apricots, peaches, pears, nectarines, prunes, and figs, all of which thrive in the rich, mellow soil of that section. The elevation of the tract is all above 1,600 feet and is not adapted to citrus fruits. The area actually irrigated is about 1,200 acres, and the duty of water or the volume required annually is from 1.5 to 2 feet in depth, or 1.5 to 2 acre-feet of water per acre of land.

WATER-RIGHT CONTRACTS.

All of the land under the system is sold with a clause in the deeds apportioning "one-eighth of 1 miner's inch of perpetual flow of water from April 15 to November 15 of each year for each acre." This would be equivalent to 1.06 acre-feet of water per acre, which has been found insufficient for satisfactory irrigation. The rates charged for water are $2 per acre per annum, with an additional charge of $1 per acre for each service of a tract during the nonirrigating season, which is stipulated to be from November 10 to April 10.

There has been no litigation between rival claimants to the water of the stream, and none over the rates at which the water is sold.

GENERAL CONCLUSIONS.

The investigation of this subject has impressed the writer with the fact that the present method of filing and recording claims to water under the laws of this State is extremely unsatisfactory, indeterminate, and unbusinesslike, leading to endless litigation and confusion. The system should be replaced by something more intelligent, positive, and rational. Filings and claims to water should be reduced to actual title, as clear and unassailable as titles to land. This can be accomplished only by and through State control, and the establishment of a central office of record, under a State bureau, empowered to adjudicate all claims to water. This State board should be a permanent commission, like the State board of health of Massachusetts, who would appoint a State engineer, in whose office all claims should be filed. There should be in this office two sets of records, the first of which should be in the nature of a preliminary or probationary filing. All claims of whatever character should be received and recorded in the probationary record in the order of their receipt, all claims upon any stream or its tributaries being arranged systematically together. Prior to transferring any claim into the second or permanent record it should be passed upon by the board, who should require the claimant to prove conclusively, at his own expense, (1) that there was water available for appropriation and that there were no prior claims in conflict; (2) that there existed a requirement for the water proposed to be appropriated, and (3) that the claimant had the ability, financially or otherwise, to properly utilize the water. In case of a conflict, the board should summon all prior claimants to prove their rights, and on hearing of testimony enter a final decree upon the permanent record establishing these rights. The State engineer should establish permanent gaging stations on all streams and maintain such a system of measurements as will determine the minimum, maximum, and average volume of water supply available for appropriation and use. The board of control would have to be endowed with judicial powers, and their adjudication of rights should be final, subject only to review by the supreme court of the State.

The doctrine of riparian rights is wholly inapplicable to the torrential streams of the State, whose waters should be subject to appropriation by impounding reservoirs unhampered by the assertion of this right. It has been shown in the two cases cited that riparian owners stand ready to invoke the law to destroy any impounding dam, no matter how costly or necessary to the welfare of the public, to satisfy a fancied injury to water rights on streams that are dry a large portion of each year, and of no practical utility to these riparian owners or anyone else without storage reservoirs. The law of riparian rights should be modified to exclude interference with impounding reservoirs of superior public utility to the greater number of the people.

The fullest conservation and use of water in torrential streams can be brought about only by storage, and as a preliminary step all storage possibilities should be intelligently studied on all the streams of the State by the State engineer, under the direction of the State board of control. This involves an extended water survey of the State and all the available reservoir sites within its limits. In this survey many reservoir sites and storage enterprises will be discovered of such magnitude as to be feasible of construction only by the National Government. These will, in most cases, be located on Government land, and will store water for the irrigation of a portion of the public domain only. Such enterprises should properly be undertaken by the National Government, and the water supply thus conserved be turned over to the State board of control for its proper distribution to the consumers.

In pursuance of the foregoing conclusions, I respectfully submit the following recommendations:

(1) There should be created in California a special tribunal, entitled "The board of control of waters," who shall have the determination of existing water rights

and the control of the establishment of rights hereafter. This board should consist of one attorney, one business man, and one civil engineer, all of good character and established reputation, to be selected and appointed by the supreme court of the State, and to hold office until removed for cause. The salary of the members of this board should not be less than $3,000 per annum each, and it should be allowed a clerk at a salary of $1,800 per annum, to be appointed by it.

(2) There should be an executive officer of the board, appointed by it, who should be a competent, experienced civil engineer, and have supreme control over the administration of the water supply and its distribution to the parties entitled to its use. The title of the officer should be "State hydraulic engineer."

(3) The State legislature should by statute declare that the common-law doctrine of riparian rights is inapplicable to the prevailing conditions in California, except so far as to make riparian owners on streams preferred users of the natural stream flow for domestic and stock purposes.

(4) The statutes of California passed for the government of the appropriation of streams should declare that all unappropriated waters not utilized for irrigation at the date of the passage of the act, either by canals or reservoirs, are public property, and all irrigation rights to be established hereafter shall be attached to the land for which the appropriation is made. The volume permitted to be appropriated should in all cases be limited to the actual necessities of economical use, to be determined from time to time by the State hydraulic engineer. Priority of use should give the better right as between parties using water for the same purpose.

(5) There should be entire harmony and cooperation between the State and National governments, looking to the fullest possible use of the waters of the State for irrigation, particularly in all cases where the diversion of water from the streams may tend to render navigable streams nonnavigable. To accomplish this purpose the National Government should take measures for canalizing the rivers and make slack-water navigation on the streams, thus giving maximum navigability with minimum use of water. A wise adjustment and determination of the volume which can be safely taken from the tributaries of navigable streams for irrigation without interfering with slack-water navigation should be urged upon the National Government as an urgent necessity.

(6) The work of the National Government in promoting irrigation development, in addition to the improvement of navigation, should also include the fullest protection of the forests, construction of storage reservoirs for impounding water to be used on the public lands, and a continuation of the hydrographic and topographic work of the U. S. Geological Survey and the work of the U. S. Department of Agriculture for the promotion of improved economic methods of irrigation.

(7) National aid in constructing storage works to be chiefly used for private lands should be discouraged, although cases might occur where reservoirs built to serve public lands would also be serviceable to adjacent lands in private ownership that had once been owned by the United States. In such cases the use of reservoired water for private lands should not be prohibited.

(8) The use of water for domestic purposes should take precedence over all other uses. The use of water for the production of power applied to the pumping of water for domestic purposes and irrigation should be recognized as next in right. In those

sections of the State where mining is the prevailing industry, mining rights to water should also take preference over all other uses, domestic use alone excepted.

(9) The governor of the State should be asked to appoint an expert nonpartisan commission to frame an irrigation law or laws which should fit and adapt the foregoing recommendations to the State constitution, and present the results in the form that they should be passed by the State legislature.

(10) The State board of control should be intrusted with the power and duty of fixing equitable rates for the sale of water for irrigation by private reservoir and canal companies, as well as for the sale of water rights.

RECOMMENDATIONS OF SPECIAL AGENTS AND EXPERTS.

As has already been stated, each expert in charge of an investigation has based his conclusions on the facts gathered in his particular field, and these conclusions are made a part of his individual report.

After the work was completed a conference of the experts was held at Berkeley, which showed that there was a practical unanimity of opinion among them regarding the more important measures necessary to develop to the fullest extent the agricultural possibilities of California. The conclusions they reached and their recommendations are given below.

It is the duty of the State:

(1) To fix the priority and limitations of every existing right to water, whether based on the ownership of riparian lands or on beneficial use.

(2) To determine the volume of unused or unappropriated waters.

(3) To declare unappropriated water State property and define the procedure whereby rights thereto may be acquired.

(4) To exercise adequate supervision and control when new appropriations are sought.

(5) To provide an office in which shall be kept a complete record of each perfected right, of each application and of each permit for a new diversion or use.

(6) To divide the State into administrative divisions and districts based on drainage lines.

(7) To provide an efficient administrative system with proper officers for the distribution of the water supply among those entitled to its use.

For the accomplishment of these purposes they recommend the following legislation:

BOARD OF CONTROL.

(1) There should be created in California a special tribunal entitled "The board of control of water," which shall have the determination of existing water rights and the control of the establishment of rights hereafter. This board shall consist of one attorney, one business man, and one civil engineer, all of good character and established reputation, to be selected and appointed by the supreme court of the State, and to hold office until

removed for cause. The salary of the members of this board should not be less than $3,000 per annum each, and they should be allowed a clerk at a salary of $1,800 per annum, to be appointed by the board.

STATE HYDRAULIC ENGINEER.

(2) There should be an executive officer of the board, appointed by them, who should be a competent, experienced civil engineer, and who should have exclusive control over the administration of the water supply and its distribution to the parties having legally established rights to its use. The title of this officer should be "State hydraulic engineer."

UNAPPROPRIATED WATERS DECLARED PUBLIC PROPERTY.

(3) The statutes of California should declare that all unappropriated waters not utilized for irrigation at the date of the passage of the act are public property.

LIMITATION ON RIGHTS.

(4) All irrigation rights to be established hereafter shall be attached to the land for which the appropriation is made. The volume permitted to be appropriated should in all cases be limited to the actual necessities of economical use, to be determined from time to time by the State hydraulic engineer. Priority of use should give the better right as between parties using water for the same purpose.

DOMESTIC USE TO BE A PREFERRED RIGHT.

(5) Domestic use of water should take precedence over all other uses.

ALL RIGHTS TO BE BASED ON USE.

(6) Beneficial use should determine the extent of every acquired right to water as well as of the riparian owners as of the appropriators. No riparian owner who has not made beneficial use of his water should acquire title to water under any doctrine as against those who have put water to a beneficial use.

BOARD OF CONTROL TO FIX WATER RATES.

(7) The board of water control should be vested with the authority to fix water rates now possessed by county supervisors, city councils, or boards of trustees of municipalities.

RIGHT OF EMINENT DOMAIN.

(8) The right of eminent domain should be given to users and conveyers of water for irrigation.

GOVERNOR TO APPOINT A COMMISSION TO FRAME LAWS.

(9) The governor of the State should be asked to appoint an expert nonpartisan commission to frame an irrigation law or laws, which should fit and adapt the foregoing recommendations to the State constitution and present the results in the form that they should be passed by the State legislature.

The agents and experts further recommended—

STATE AID TO DISTRICTS.

(10) State aid should be extended—

(a) To the extent of projecting and supervising works whenever constructed for an organized district. Districts, in the case of storage works, should include all irrigation works and lands that will be benefited by the water stored.

(b) To the extent of actual construction of works under a proper regulation for the recovery of its outlay in whole or in part from the lands benefited in proportion to the benefits conferred.

NATIONAL AID.

(11) The work of the National Government in promoting irrigation development, in addition to the improvement of navigation, should also include the construction of storage reservoirs for impounding water to be used on the public lands; a continuation of the hydrographic and topographic work of the Geological Survey, and of the work of the Irrigation Investigation of the Department of Agriculture for the promotion of improved economic methods of irrigation.

COOPERATION OF STATE AND NATIONAL GOVERNMENTS WITH ESPECIAL REFERENCE TO SACRAMENTO AND SAN JOAQUIN RIVERS.

(12) There should be entire harmony and cooperation between the State and National Governments looking to the fullest possible use of the waters of the State for irrigation, particularly in all cases where the diversion of water from streams may tend to reduce their navigability. To accomplish this purpose the National Government should take measures for canalizing these rivers, thus giving maximum navigability with minimum

use of water. A wise adjustment and determination of the volume which can be safely taken from the tributaries of navigable streams for irrigation without interfering with slack-water navigation should be presented to the National Government as an urgent necessity.

FOREST MANAGEMENT.

(13) Both Federal and State aid should extend to forest preservation. Practically all timber land should be withdrawn from sale, and timber should be cut under regulation at fixed charges for stumpage. Revenue from the sale of timber should be applied to betterments and extensions of the forest areas and to the control and management of the forests.

NATIONAL AID FOR PRIVATE LAND DISCOURAGED.

(14) National aid in constructing storage works to be chiefly used for private lands should be discouraged, although cases might occur where reservoirs built to serve public lands would also be serviceable to adjacent lands in private ownership that had been once owned by the United States. In such cases the use of reservoired water for private lands should not be prohibited.

RECLAMATION OF PUBLIC LANDS.

(15) Federal aid, for the present, should not be extended to actual construction of works, except when the lands, or a large portion of the lands, to be benefited belong to the public domain. The price at which the land is sold should be increased by an amount sufficient to reimburse the Government for its outlay; or the sale can be supplemented by a rate charge or tax for a series of years such that ultimately the funds advanced in the construction will, in the main at least, be returned to the National Treasury. No works should be constructed unless the benefits conferred will exceed the cost.

Recommended by:

Wm. E. Smythe,
Marsden Manson,
J. M. Wilson,
Frank Soulé,
C. E. Grunsky,
C. D. Marx,
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Agents and Experts in Charge.

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